THE EXPLOITATION OF FISH DURING THE HOLOCENE IN THE SOUTH- WESTERN CAPE, SOUTH AFRICA.

CEDRIC ALAN POGGENPOEL

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DEPARTMENT OF ARCHAEOLOGY

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TO MY PARENTS

RAY, JOHN

AND GWENNIE

ABSTRACT

This thesis describes the fish remains recovered from a number of sites in three different localities in South Africa; Elands Bay and Langebaan Lagoon on the west coast, and False Bay on the Cape Peninsula.

Chapter One is an introductory account of ichthyology, its usefulness in archaeological research and the range of analytical work done in South Africa, whilst Chapter Two is an attempt to show the history and development of the study of fish bones recovered from prehistoric sites in South Africa.

Chapter Three gives an account of the southern Oceans, the Benguela Current and fishing habitats. Chapters Four and Five give accounts of the fishing habitats within the Elands Bay area and of the identification and interpretation of fish assemblages excavated at four sites and their implications in relation to habitat and palaeoenvironmental changes at Elands Bay. This information is used first to show that the presence or absence of certain species and the size of those species in the archaeological record can be used as an alternative means to interpret late Pleistocene and Holocene sea level fluctuations and to understand to what extent local fishing habitats have been influenced by those changes. An important observation made was the relative surplus or deficit of vertebrae compared to cranial parts through the sequence. The over-representation or under-representation of fish vertebrae in the fish assemblages points to changes in the procurement strategy employed. The consistency between cranial:vertebral ratios through the site sequences suggests that these patterns are related to both location and processing techniques.

Chapter Six reviews the ecology of the Langebaan Lagoon, the identification of fish assemblages from three open midden stations; Stofbergfontein on the shores of the lagoon and Paternoster and Duiker Eiland which are located on the Vredenberg peninsula. Chapter Seven gives a short overview of the modern fishing situation at False Bay and

discusses the fish assemblages from Smitswinkelbaai Cave and Rooiels Cave in the False Bay area.

Chapter Eight deals with the archaeological evidence for fishing equipment and the depiction of fishing scenes in the rock art of South Africa and addresses the historical evidence for indigenous fishing in the south-western Cape. Chapter Nine gives an overview of the historical fishing at the Cape, the use of outposts near Langebaan Lagoon and Muizenberg in False Bay by the Dutch to supply the Cape settlement with provisions. In Chapter Ten the relevant evidence from each of the chapters is summarised and the conclusions for the three areas are presented.

ACKNOWLEDGEMENTS

It is difficult to conduct a project of this nature without the assistance and co-operation of many people, and I would like to thank all those that have participated at one time or another. My supervisor, John Parkington who initiated the Elands Bay project and knows the excitement and frustrations that we have had as the project developed during the excavations and at the University. I am most grateful for his infectious enthusiasm, his many suggestions and for supervising this project. Ray Inskeep was inspirational in starting the fish identification programme and I am indebted to him for giving me the opportunity to continue research at the University.

Professors Martin Hall, John Parkington, Nick van der Merwe, Judith Sealy, Andrew Sillen and Andrew Smith, who are all members of the Department of Archaeology, made it possible for me to register at the University, and I thank them for their sustained encouragement and the confidence that they have shown in my ability to complete this assignment.

The following persons have given me access to their archaeological fish samples, without which this research could not have succeeded; Ray Inskeep, John Parkington, Richard Klein, Tim Robey, Peter Robertshaw, Carmel Schrire, Martin Hall, Andrew Smith and Sharma Saitowitz. My gratitude is also extended to my father, Abel Poggenpoel, in his capacity as a professional fishermen, for the many fish samples that he has collected and for the long discussions we have had on various fish species, their availability and habits in and around the False Bay area. Thanks are due to Mary Leslie and Judith Sealy for commenting on this thesis. Dawn Fourie, Mike Herbert and Tony Manhire helped in various ways while Royden Yates, John Lanham and Chris Henshilwood have been unfailingly helpful in providing computing assistance in the final stages of this project.

A special word of thanks is due to my wife, Gwennie, who is a constant source of encouragement and who has participated in many of our archaeological expeditions, but especially for her support and inspiration over the last five years.

BIOGRAPHIC PREFACE

Like many a Kalk Bay lad, I am the son of a fisherman. My family has lived in Kalk Bay for four generations wresting a living from the sea rather than from the land. My great grandfather worked in Kalk Bay as a whaler and his son, Dirk Poggenpoel, at eighty years of age, became the oldest working fisherman in the False Bay area. My father, Abel Poggenpoel, is still fishing and working one of the family boats from Kalk Bay.

From what I can remember, the first time I made contact with the sea was when Michael Gomez took me down to the harbour at the age of six years to watch the fishing boats return with their daily catches. He carried me on his shoulders and took me to the edge of the pier; there he dropped me into the water and encouraged me to swim. After that incident I lost my fear of the water and learnt to swim very quickly. In those days it was believed that all Kalk Bay children should be able to swim and pushing people in the water at the harbour was a common thing to do.

My early schooling started at the Holy Trinity primary school in Kalk Bay and every day after school we used to go to the harbour to participate in selling fish, cleaning boats and sometimes fishing from the pier to earn pocket money. As I got older the duties changed to going out with the boats to fish for bait, removing entangled lines from the prop shafts, making copper traces for fishing and going to the abattoir in Simonstown to collect blood for strengthening the cotton lines for fishing. One of my major problems was that everytime I went to sea I got sea sick. I would have done anything not to go to sea but coming from a fishing family I was compelled to go to sea over weekends and other holidays.

I left school at the age of sixteen and whilst waiting for my matric results decided to spend the summer holidays with my mother's family in Sunny Dale near Fish Hoek, to avoid having to go to sea. An interesting bit of history is that my mother's family name is Skilder. They lived just below the mountain ridge where Skildergat is situated. My grandfather was the conservationist for the Skildergat Kop area, where his job entailed the

protection of wild life, preventing people from squatting in the area and sounding the alarm in the case of veld fires. During the late eighteenth century a man by the name of Skilder had lived in the Tokai area on a farm as a "bywoner". At some later stage there had been a dispute over payment and he had stolen some sheep and a few head of cattle and disappeared over the mountain into the Fish Hoek valley with his family. He had found a cave just below the escarpment in the valley and lived there for some time. The cave, Skildergat, was named after him and later it was renamed Peers Cave. It is possible that he was my ancestor since there were no other people of that surname living in the Fish Hoek valley and all the people with the name Skilder that I know of, living in the Peninsula area today, are decendants of or related to my grandfather.

During my stay in Sunny Dale, Andrew Truter, who was a close friend of mine and who had completed his schooling at the same time, became mindful of our cash-flow position and kept a weather-eye on newspaper columns which might yield vacation jobs. During this period nothing really excited me where jobs were concerned, but Andrew was intrigued by an advertisement which called for assistance for a lady archaeologist who was to conduct an excavation at Peers Cave in the Fish Hoek valley. He applied for the job and was awarded the position of field assistant.

Meanwhile I had scant interest in digging up bones and artefacts and went about my holiday alone, not realising that my future was even then being planned, all unknowingly by my friend's mother. For Mrs Truter had no intention that her son should become a hole-digger, and she found him a job with the respected local firm of Irving and Johnson. Now Andrew was in a quandary. Not averse to his mom's choice of career, he was nevertheless reluctant to abandon Barbara Anthony, his new employer, to the exigencies of an archaeological dig; the work involved carrying the excavated material down the mountain and the dangers of solitude and the onset of bad weather became issues as the year progressed.

Andrew approached me about taking over from him so that he could take up the new position with Irving and Johnson. It took some convincing on his part to get me to stand in for him, because at the time it was very difficult to see a career at the bottom of a pit in a cave on top of the mountain. But friendship prevailed and I was finally persuaded to assist the lady archaeologist at Peers Cave.

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Barbara Anthony had originally come to South Africa to undertake her Ph.D on the Middle Stone Age (MSA) of southern Africa. It had not been her intention to excavate archaeological sites, but to study the existing excavated collections in the National Museums. She quickly discovered, however, that the available material was inadequate and it was thus that she decided to explore the possibilities of digging at Peers Cave where the famous Fish Hoek Man had been found. The site had first been excavated by Mr Victor Peers and his son under the guidance of John Goodwin the resident archaeologist at UCT. They had discovered a long sequence of occupation with large quantities of MSA artefacts and a human skeleton. Since the material was not dated, Barbara Anthony's objective was to locate the MSA horizons found by Peers and to find suitable wood charcoals that could be dated by the radiocarbon method. The excavated material was all transported to the South African Museum, and when the excavation was completed the analysis of the MSA material was conducted at the Museum.

I continued to work for Barbara after the excavation and it was certain that she sensed the potential in her young assistant even if I was slow to recognise it myself. She gave me a number of books to read, and introduced me to some influential people, like the then head of the Department of Archaeology at the University of Cape Town, Ray Inskeep. He mentioned that, if I was interested, he could see what the possibilities were of finding me a position at the University. In the meantime a position became available in the Taxidermy Department at the Museum. At first I was not interested in applying for the job, but Reinold Rau who was head of the Taxidermy Department suggested that I apply since the job was only temporary until Moegamat Tape, who was the assistant, returned from a training course in Germany. I then applied and was employed by the Museum.

The job entailed reconstructing the old fish gallery in the marine section. This gave me the necessary background in preparing specimens for casting, and skills to transfer plaster of paris casts to glass fibre. The skin colour of these specimens had to be painted and the museum arranged for me to attend art classes at the Michaelis Art School to learn the necessary skills in drawing and the mixing of paints. These practical experiences became instrumental in establishing an understanding of ichthyology.

During my stay at the Museum I started to work with other researchers like Brett Hendey, doing some Palaeontology, collecting bones from Hopefield and Swartklip near Strandfontein. The collecting of fossil bones allowed me to develop my digging skills and to learn how to accession and how to reconstruct mammal bones in the laboratory.

One year later Moegamat Tape returned from his overseas trip and was re-employed by the museum. Reinold asked me to stay on, but I felt that I needed a break and left the museum. Later in 1964 I was employed in the Department of Photography and Printing of the South African Navy at Simonstown. Whilst I was working there, Ray Inskeep contacted me, and told me about Charles Keller, a student of Desmond Clark, who had come to South Africa from the United States of America to study the Early Stone Age (ESA) in South Africa. He intended to excavate a large cave near Montagu and he desperately needed a person with digging experience who could communicate with an Afrikaans speaking crew. Ray Inskeep pointed out that the experience I would gain by participating in the project would stand me in good stead if I still wanted to join him at the University. I decided to go to Montagu and worked for Charles for the following nine months, excavating Montagu Cave. At the end of the field trip I joined the Department of Archaeology at UCT. During my first year at UCT Ray Inskeep allowed me to attend all lectures in Archaeology, which opened a new dimension to what I knew about Archaeology. He made his personal library available to me and through his guidance taught me most of the excavation skills I used in later years.

At the end of 1965 Ray mounted another expedition to Plettenberg Bay where he had started an excavation at Nelson Bay Cave the previous year. The site is right on the coast and yielded an enormous amount of fish bone. Because of my earlier encounter with fish at the museum I recognised some fish species in the archaeological samples. Ray then suggested that I start by collecting comparative specimens that could be used to identify the many fish bones from the site. The initial idea was to identify some species and to arrive at a Minimum Number of Individuals (MNI). For the following two years this was what I did for most of the time, building up the comparative collection and teaching myself all about fish bones.

In 1966 John Parkington came from England and joined our Department. His influence and enthusiasm for the subject brought new interest in

understanding archaeology beyond the borders of Southern Africa. He taught me all about European Archaeology, its complexities and how diversified it was. His interest in the European Mousterian led to a search for MSA sites on the Cape Peninsula. Eventually he ended up researching the Later Stone Age (LSA) in the south-western Cape. After a number of rock art field trips to the Cederberg, John, Graham Avery and I set off to excavate a site called De Hangen. This was our first excavation together and it formed the beginning of a long partnership in doing field work together. A number of excavations in the Cederberg followed which formed part of the research programme conducted by John in the Olifants River Valley. The archaeology of De Hangen indicated that the occupation horizons in the cave accumulated during the summer months. This led to the search for other sites that may have been occupied during the winter months. The presence of a number of marine shells in the deposit pointed to contact with the coast and later we found a large cave near Elands Bay which we excavated over a number of years. The excavation revealed a long sequence of occupations with large quantities of fish bone, which I started to analyse. Little by little greater emphasis was placed upon the analysis of fish remains as more and more coastal sites were excavated by other archaeologists. They sent all their fish remains to me to be identified. In 1966 Tim Maggs started his Ph.D research on the Iron Age in the Orange Free State and during 1967 I joined him in excavating some of the larger sites near Ventersdorp. The techniques involved in excavating Iron Age sites are very different from those used for digging open LSA middens and cave deposits. This type of archaeology gave me another insight into dealing with stone buildings and exposing kraal walls and hut floors. At the end of that year we went to a site near Lindley and started excavations there. The site is situated on a low ridge called Makgwareng which stretches for about two kilometres. We selected one of the homesteads that was slightly separated from the rest of the site complex. The site had a central kraal with a number of corbelled huts. This site was one of the largest sites excavated by Tim and we spent two seasons here. During our stay at Lindley I used to take long walks on Sundays and on one of those occasions, found a depression in the back of a kraal which looked suspiciously like a burial. I told Tim about it and after a long discussion we decided to excavate the depression. After two days of digging I exposed the

top of a human skull in the pit. Since this was my first human burial I stopped digging and went down to call Tim. There was great excitement in the camp and champagne was served that evening with supper. The following year I got married and my wife Gwennie went with us to Lindley. With her help, I excavated three more burials that were buried in different deposits i.e. one in a midden, one in a quarry and one in a clay pot. This variation in the selection of where people were buried showed that no particular area was chosen as a burial place at Lindley during the Iron Age.

In the interim a number of important developments made me realize that archaeology was where I should place my energies. The first was the joint publication of the De Hangen report with John Parkington. This was a major achievement since my name had never been in print before.

In 1973 the University sent Ivan Hanival and myself on a two week educational tour to visit all the National Museums in South Africa. The aim was to assess the archaeological displays and methods of accessioning artefacts. This experience would help us to improve our own museum displays and methods of recording the many artefacts housed in the Archaeology Museum at the University.

The third significant development was that I was accepted as a member of the South African Association of Archaeologists. The overwhelming support that I received from my colleagues and members of the association made me feel that I had truly become part of the archaeology fraternity.

In 1983 Carmel Schrire came to South Africa and started an excavation at Oudepost I on the Churchhaven Peninsula and I went with her to excavate the site. The excavations lasted for three seasons and became one of the major historical excavations in the western Cape. In 1984 I was awarded the position of Senior Technical Officer in the Department of Archaeology and became the first person to hold this position in the Arts Faculty.

In 1985 I became the first South African to receive a fellowship from the LSB Leakey Foundation, to study Archaeology and Palaeontology at the University of California, Berkeley for a period of six months. This was my first trip overseas and I must thank Desmond Clark, James Deetz, Carmel Schrire and John Parkington for making it possible for me to attend the course at Berkeley.

In 1989 Martin Hall, John Parkington and Andy Sillen suggested that I register for a Masters degree in Archaeology at the University. Since I have never had any tertiary education a special arrangement was made for me to be accepted. A meeting was held with the Dean and members of the faculty of Arts and after a number of letters of support from members of our Department to the University, I was allowed to register as a student in the Department of Archaeology.

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CHAPTER ONE

INTRODUCTION

Ichthyoarchaeology is a term not commonly used in the southern African archaeological literature, partly because it has rarely been exposed to archaeologists as a viable subject that can address problems relating to issues other than fish identification. Recent studies of fish remains from archaeological excavations have shown that archaeologists concerned with coastal, riverine or lacustrine sites may gain much information on human diet, settlement patterns and changing environments in the past from the analysis of fish bones (Stewart 1989; Wheeler & Jones 1989). The techniques involved in studying fish remains have greatly improved in recent years, and the identification of species, minimum number estimates and size ranges of different fish species are commonly given in archaeological publications.

This thesis reports on the study of fish remains recovered from archaeological sites which were excavated in three localities, Elands Bay, Langebaan Lagoon on the west coast and False Bay adjacent to the Cape Peninsula. The sites in these areas were chosen as a potential source of information that can help interpret prehistoric and historic economic settlement patterns, by focussing on different fishing habitats in the past. The thesis will examine the utilization of different fishing habitats, and make some intersite comparisons with particular reference to the fish species represented in each assemblage and inferences to be derived from differences in their relative abundance and diversity. The fish bone will also be used to help interpret sea level and other environmental changes during the late Pleistocene and Holocene. Another focus will be the effects of changing fishing techniques on the overall organisation structure of fishing adaptations in marine and estuarine components of coastal human

settlement. Since the 1960s, great progress has been made in the investigation of prehistory in southern Africa, but prior to this period very few archaeological sites were adequately excavated, with much emphasis placed on the origins of people and on long stratigraphic sequences chosen to understand the development of technological change through time (Goodwin & van Riet Lowe 1929; Goodwin 1938a, 1946). Subsequently more consideration was given to finding possible evidence for environmental change, economic subsistence strategies and seasonal and spatial patterning in archaeological sites (Clark 1959; Deacon 1976; Parkington 1976a; Inskeep 1978).

1.2: Fish bone analysis

Fish bone differs from terrestrial mammalian bone in that it is less dense and fragments more easily. The validity of many of the dietary calculations applied to assemblages of archaeological fish remains must be questioned since many fish bones readily disintegrate as a result of the processes which occur on human occupation sites. The preparation of fish for drying, the consumption of fish on site, whether by people or animals, cooking fish on open fires and the discarding of bone after eating may all cause fish remains to disappear from the archaeological record. When the bones of large terrestrial mammals are compared to fish bone, the mammal bone is always over-represented because of its size and durability (Wheeler & Jones 1989).

The retrieval method applied in all the sites examined in this thesis have been the same and I have been fortunate to have participated in all the excavations. Two types of sieves have been used, the material from the 12 mm sieves was sorted and packaged on site, while fish remains from the 3 mm sieves was often sorted at the University laboratory. Minimum Number of Individual (MNI) counts were achieved by sorting for as many cranial parts as possible, although most species identifications were made on premaxillae and dentary bones (Appendix B).

1.3: Estimation of fish size

The size of a whole fish can be recorded in a number of different ways; these include the standard length (tip of the snout to the end of the hypural plate), fork length (snout tip to the fork of the tail), total length (snout tip to tail extremity) and head length. Fork length (FL) was the measurement used for the comparative sample with which the archaeological specimens have been compared (Morales & Rosenlund 1979; Wheeler & Jones 1989) (Figure 1:1). The comparative fish bones selected for measurement were the premaxilla, maxilla, dentary, atlas, entopterygoid, basi-occipital and urostyle. Experience has shown that these are robust elements that survive well in archaeological contexts and have strong points to measure. A single regression analysis has been used to show the relationship between fish bone size and fish length. This method requires only one regression equation for each bone of each fish measured and is highly accurate (Lepiksaar 1973; Van Neer 1989; Wheeler & Jones 1989). A number of comparative fishes with a series of size ranges that might have been exploited in the past were selected to compare with the most common species found in the archaeological deposit. In the case of the white steenbras, *Lithognathus lithognathus* and white stumpnose *Rhabdosargus globiceps* the premaxillae and dentaries were used. In the case of the flathead mullet *Mugil cephalus* and southern mullet (harder) *Liza richardsoni* the atlas and basi-occipital were used. The results of these size estimations will be discussed in Chapters Four and Five.

1.4: Species identifications, MNI and body parts

Marine fishes most likely to be found in archaeological deposits are those that belong to the *Osteichthyes* family of bony fishes (Smith 1953; Day 1969). In these fishes the cartilaginous skeleton has been replaced by bone and a number of bones known as membrane bones have developed. Because of the robustness of the bones they have a greater chance of survival in archaeological deposits. Bones from the head skeleton that are the most reliable for species identification, are the premaxillae, maxillae, dentaries and sagittal otoliths which occur as paired bones in each individual fish.

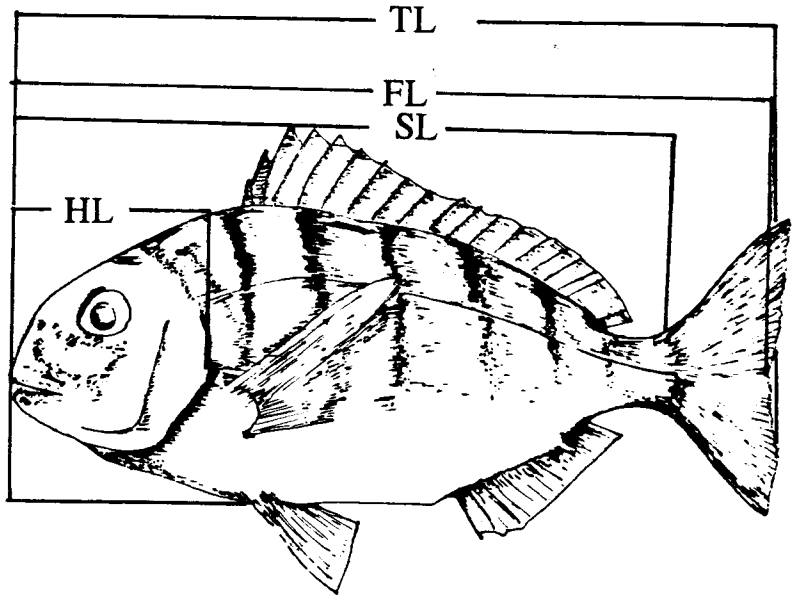


Figure 1:1. Length measurements taken on comparative fish specimens, TL = Total length, FL = Fork length, SL = Standard length, HL = Head length.

Other bones in the neurocranium such as the supra-occipital, prevomer, basi-occipital and parasphenoid, which are single elements, have also been used in cases when mandible counts were low (Poggenpoel 1984; Wheeler & Jones 1989). The shapes of mandible bones are more species specific and allow for greater accuracy when identifying species. The atlas vertebra and urostyle, which are the first and last vertebrae in the vertebral column, as well as the first dorsal and anal spines, have also given good Minimum Number of Individual results. To calculate the taxonomic abundance of an archaeological site it is necessary to determine the number of individuals of different animal taxa present. The most common criteria used is the Minimum Number of Individuals (MNI) represented for each taxon, and the Total Number of Identifiable Elements or Specimens per Taxon (NISP). Most discussions of taxonomic abundance have been based on mammalian dominated assemblages but researchers dealing with other biological indices have adopted this method of quantification and element assessment (Klein & Cruz-Uribe 1984; Stewart 1989; Avery 1990).

The MNI method is an effective assessment of taxonomic abundance but has its drawbacks. It tabulates numbers of individuals but ignores both differential numbers of elements between groups and differential preservation of elements among groups. It does give a basis for calculating meat weights and biomass of individual species that can be correlated stratigraphically within and between sites. At the same time it does not distinguish between whole animals and animals that may have been shared amongst other groups. Rarer taxa can be over-represented in small samples and in cases when site samples are divided into smaller aggregates.

The NISP calculation is used mainly to express the abundance of skeletal elements for each taxonomic group within a given faunal sample. It can also be used as a ranking system to indicate the absence or over-representation of certain body parts, especially when comparing similar taxa in different sites. One of the major problems of using NISP as a means to determine taxonomic abundance, is that NISP considers all taxa to have an equal number of skeletal elements and disregards the differential preservation of elements in archaeological contexts. Therefore MNI and NISP figures should be used together to express taxonomic diversity, meat weight values, procurement, processing, consumption strategies and when assessing the minimum dietary contribution in a dietary package.

1.5: Environments

To reconstruct past environments and to understand the interaction between prehistoric people and their environment, it became necessary for archaeologists to specialize and study the faunal and floral remains left behind in archaeological sites by prehistoric communities (Deacon 1976; Klein & Cruz-Uribe 1984; Poggenpoel 1984; Avery 1990; Jerardino 1993). Hunting and gathering is a way of life ascribed to prehistoric groups that do not subsist through agriculture or herding domesticated animals. Their economic base is derived through the utilization of various wild resources in terrestrial, marine and aquatic ecosystems. The exploitation of coastal resources has been part and parcel of prehistoric economic subsistence strategies from at least as early as the Upper Pleistocene (Bailey & Parkington 1988).

The study of palaeoclimatic and sea level changes in archaeological research in South Africa has mainly been directed at showing that such changes in the late Pleistocene and early Holocene can be related to global environmental events (Butzer 1979; Yates *et al.* 1986; Jerardino 1993; Miller *et al.* 1993). This information has largely been derived through the study of emerged beach deposits and deep sea cores for the interpretation of long term environmental changes. The isostatic behaviour of Holocene sea levels in the Elands Bay area on the west coast of South Africa has recently received much attention by researchers, with a view to understanding the utilization of different ecosystems and subsistence strategies by prehistoric societies (Tankard 1976; Parkington 1980; Butzer 1984; Yates *et al.* 1986; Jerardino 1993; Miller *et al.* 1993).

To interpret minor resolutions of sea level oscillations and their effects on the immediate micro-environment at a site, research emphasis shifted from geomorphological to biological and botanical indicators such as the use of large and small mammals, birds and shellfish (Deacon 1976; Avery 1982; Klein & Cruz-Uribe 1987; Avery 1990; Jerardino 1993). I would like to stress here that the study of ichthyoarchaeological assemblages can add to our understanding of environmental change as well as contribute to such issues as the timing of visits to the coast and the selection of specific habitats for fishing during prehistoric times.

The large number of archaeological sites in the vicinity of the Verlorenvlei on the west coast of South Africa points to its importance as a focal location in the landscape (Figure 1:2). During the terminal Pleistocene and early Holocene this region was subjected to vigorous palaeo-environmental changes which affected the fish and other living organisms in the vlei (Parkington 1976a; Yates *et al.* 1986; Grindley & Grindley 1987; Manhire 1987; Poggenpoel 1987; Jerardino 1993; Miller *et al.* 1993). The presence or absence and size differences of certain species in the archaeological record will be used to establish palaeo-environmental changes and the selection of various prehistoric fishing habitats in the research area.

1.6: Estuarine systems

The maintenance of estuarine systems is dependant upon a continuing balance between sea and freshwater. The salinity of an estuary is determined by three factors, sea water input, freshwater input and evaporation (Heydorn & Tinley 1980; Grindley & Grindley 1987). The salinity of the water normally decreases from the mouth to the head of an estuary as a result of the decreasing amount of sea water and the increasing amount of freshwater. However, in seasonally closed estuaries of the western Cape salinity is a more complex variable. When the estuary mouth closes in summer the sea water input is cut off, but since this is also the dry season riverine input also decreases. Evaporation ensues and in shallow water high salinities occur. As there are many different types of wetlands on the west coast, the term estuary does not adequately describe them here. One wetland, the Verlorenvlei for example, may incorporate a number of different types; in its upper reaches it is a vlei while in the lower reaches it becomes an estuary and in some years a lagoon, depending on the amount of water input. Similarly, Langebaan Lagoon which is really an inlet of the sea is confusingly and inappropriately named a lagoon.

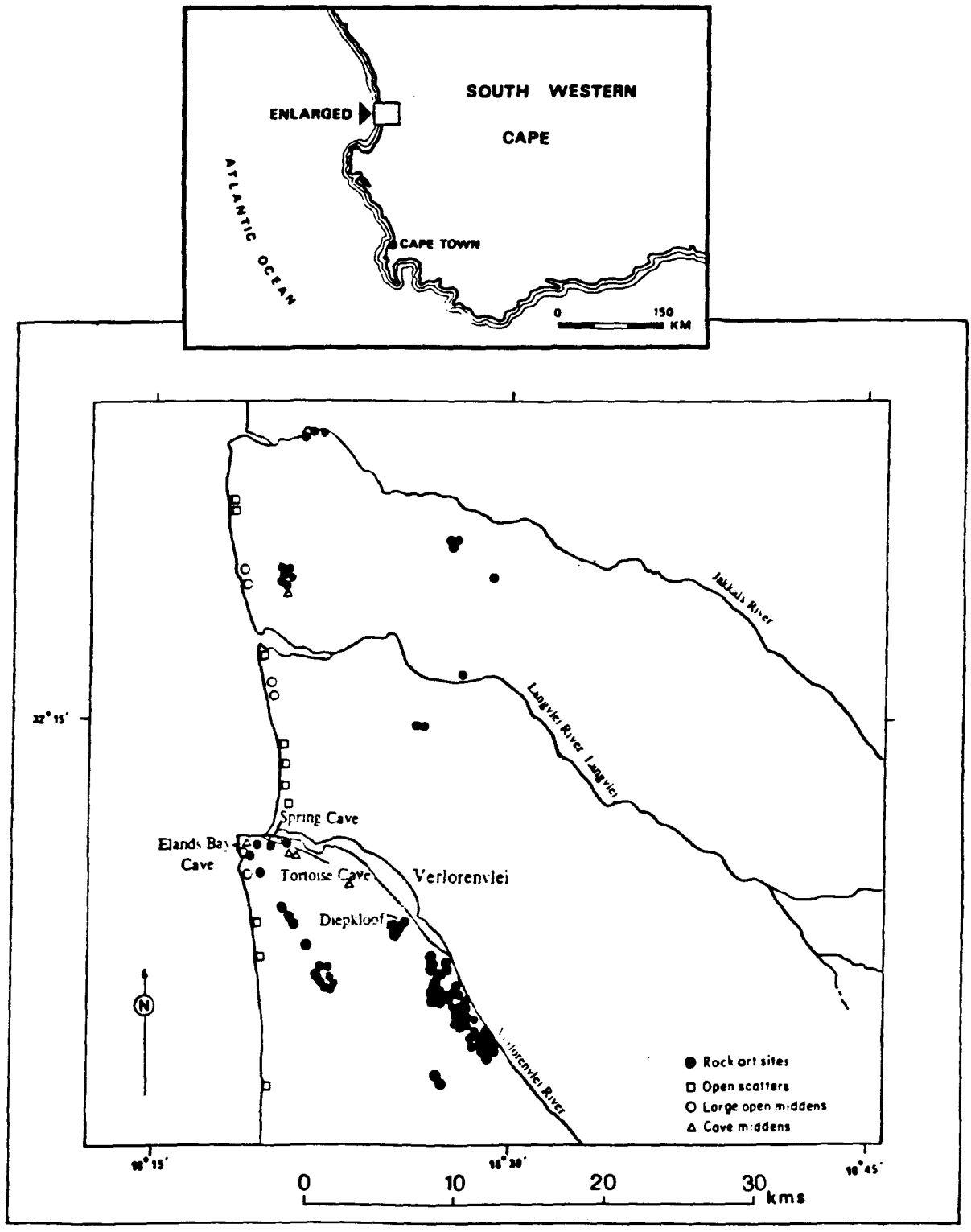


Figure 1:2. The distribution of archaeological sites in the Verlorenvlei area, Elands Bay south-western Cape.

Evidence suggests that the Verlorenvlei has been one of the major fishing habitats in prehistoric times and it is hoped that through the study of fish remains recovered from the archaeological record the effects of sea level changes on the formation of fishing habitats in the Elands Bay area may be understood.

1.7: Growth ring studies in fish scales and fish otoliths

Growth ring studies in fish otoliths and scales used by ichthyologists to determine age and sex profiles have been applied in archaeology to interpret the seasonality of occupations of archaeological coastal sites (Shawcross 1967; Casteel 1976; Patrick 1984). Although fish scales have appeared regularly in prehistoric samples, the use of otoliths seems to be more reliable in terms of species identifications. Scales do not often survive well in archaeological contexts due to their fragility, and frequently suffer loss of the outer margin. On occasion scales may separate into discrete layers which makes identification difficult (Wheeler & Jones 1989).

Some rewarding studies have been done by workers who used otoliths for information other than age determination; these include the use of otoliths to identify species and the weight of otoliths as a measure of the weight and length of the fish (Dannevig 1955; Morris Southward 1962; Mugiya 1964; Geldenhuys 1973). During the growth of a fish alternate translucent and opaque zones are laid down annually around the central core or nucleus, concentric to the outer margin of the otolith. This zonation is due to alternating high and low organic layers laid down during winter and summer. The high organic zones which appear opaque under microscopic light form during summer when food is plentiful, and the low organic layers which appear translucent form during winter. By isolating and identifying the last growth ring laid down in archaeological fish otoliths it is possible to determine the season of capture of the fish and, thus, to register the season of site occupation. This method of analysis has been tried on some of the otoliths from Elands Bay Cave with limited success due to our inability to read the last growth rings (Patrick 1984). Patrick reported that the outer edge of the prehistoric otoliths is often clouded with a dark stain which could be mineral or organic. The next stage in the analysis would be to identify which it is and to erase it from the otolith. A

number of researchers have addressed the question of seasonality with very little coherence in determining the season of occupation at sites within the south-western Cape (Parkington 1972, 1976a, 1976b, 1977, 1981; Sealy 1986; Sealy & van der Merwe 1986; Avery 1990; Woodborne *et al.* 1995; Parkington in prep.).

Many seasonal hypotheses have been established through the presence or absence of animal taxa, and it is no different for the use of fish. In many cases, notes on angling refers to 'summer' fishing or 'winter' fishing, but very seldom to autumn or spring. Summer or winter would seem to be the optimum periods recorded for many species but any one specie may still continue to be present in a particular habitat on either side of the optimum period; during autumn or spring, in lesser numbers. As a number of factors such as abundance of food, changing currents, strong winds and temperature change, may influence the seasonal patterns and a season may be extended or shortened depending on how the fish respond and react to such changes. It was decided not to use the fish remains as a vehicle to establish seasonality in sites, since it would mean that several issues need to be addressed that fall outside the scope of this thesis.

1.8: Ba, Ca and Sr measurements in marine and freshwater fish.

More recently chemical analysis has shown that strontium/calcium (Sr/Ca) ratios vary between freshwater and marine water. Freshwater has a low content of 0.0019 parts per thousand strontium whereas seawater has an average of 0.0089 (Rosenthal *et al.* 1970; Bruland 1983; Sealy & Sillen 1988; Gilbert *et al.* 1994). By comparing the strontium, barium and calcium proportions of fish that could have been caught between two environments, it may be possible to demonstrate by this technique which environment was used as a fishing habitat by prehistoric fishermen.

We have also undertaken a preliminary study in order to determine what differences, if any, there are in barium/strontium (Ba/Sr) ratios between modern samples of marine and freshwater fish. It appears that the Ba/Sr ratios in fish bone from different environments are statistically significantly different so that we can separate them and identify the habitat from which they are derived. This would imply that the application of Ba/Sr analysis to archaeological fish bone can separate fishes caught in different fishing

habitats in the past (i.e. marine, estuarine or freshwater) and should have considerable implications for archaeological research in the future.

CHAPTER TWO

THE HISTORY OF FISH BONE STUDIES IN SOUTH AFRICA

The fish bone assemblages of more than thirty sites have been examined along the South African coast from Elands Bay in the north-west to Storms River Mouth along the south-east coast (Goodwin 1938a; Deacon 1970; Klein 1972a; Parkington 1976a; Schweitzer 1979; Schweitzer & Wilson 1982; Singer & Wymer 1982; Poggenpoel 1984, 1987; Robey 1984; Inskeep 1987; Deacon & Schuurman 1992; Henshilwood 1995; Binneman in prep.) (Figure 2:1). With the exception of the earlier work done by Goodwin and Deacon at Oakhurst rock shelter and Storms River Mouth, all the fish bones recovered from these sites have been analysed by myself. The results of this work have given us a platform from which to start from and have shown the important role fish remains can play in the understanding of changing conditions and technology in the procurement of fish in the prehistory of South Africa. Although the earliest studies on archaeological fish remains were carried out more than a century ago on European sites (Sauvage 1870; Clason 1986), ichthyoarchaeological research only became an integral part of the archaeology in South Africa once ichthyologists and archaeologists had become aware of fields of mutual interest. Zoologists, experienced in dealing with fish were consulted to examine remains recovered from archaeological excavations without necessarily being involved in the final interpretation or in the retrieval of bones from the sediments. As a result a list of species identifications appeared in publications without an explanation of the quantitative importance of fish in the economy of the period under study. This is evident from the earliest studies in which fish bone was analysed (Goodwin 1938a, 1938b, 1946).

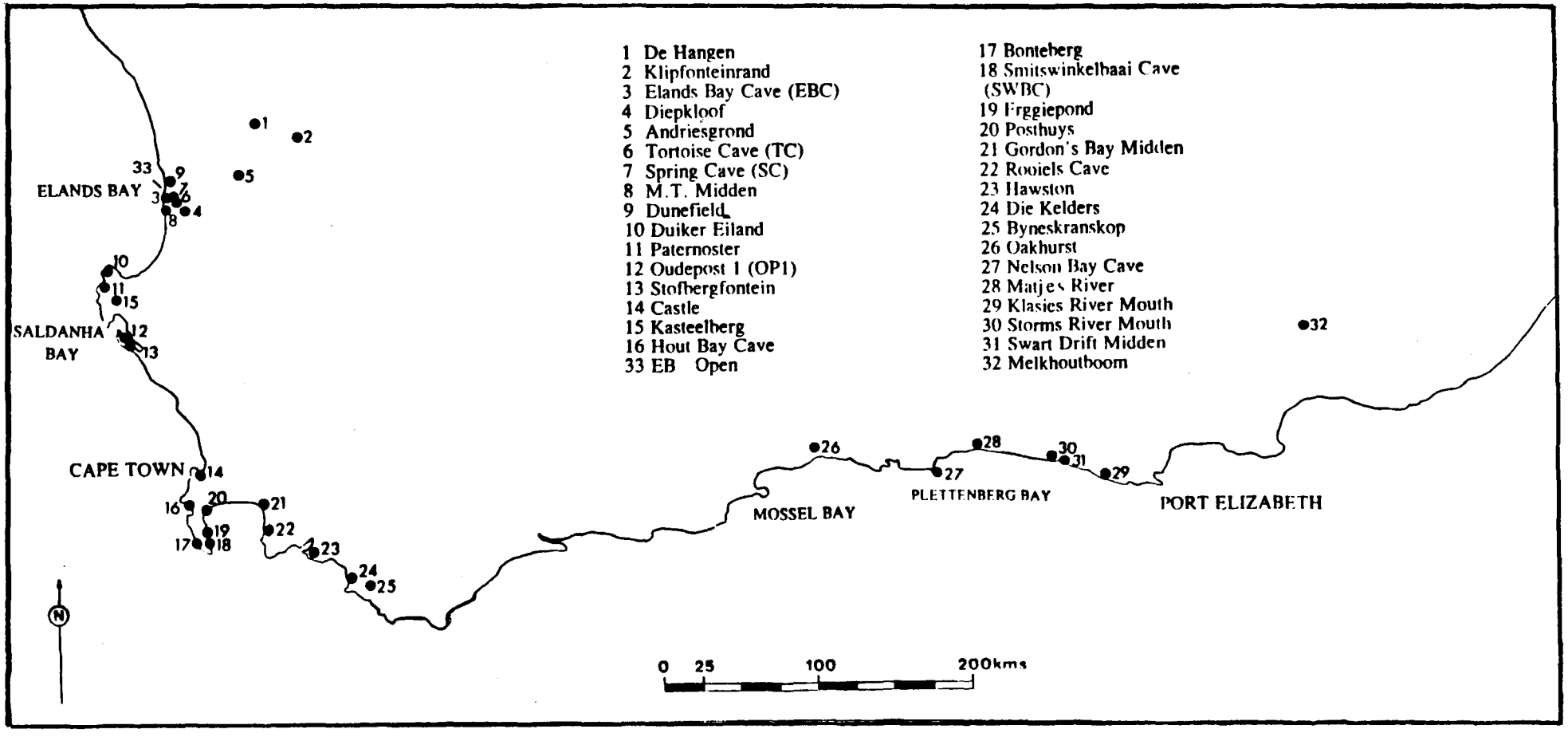


Figure 2:1. The distribution of archaeological sites with fish bone assemblages along the South African coast.

The first attempt to identify fish bones in archaeological occurrences was made by Goodwin at Oakhurst near George (Goodwin 1938a). The site is situated approximately 9 km from the town of George on the farm Oakhurst on the south-east coast of South Africa. The cave is situated some one and a half kilometres from the lakes and about 14 kilometres from the sea. Goodwin and Hails first started excavations at the site in 1932 and opened a substantial trench down to bedrock over a period of three years. The site yielded large quantities of LSA faunal and cultural material. The fish bone was analysed by Barnard who was then the resident ichthyologist at the South African Museum. He gave a description of some of the bones found, which reads as follows; "A supra-occipital bone of large fish, probably Biskop. Dorsal spine of Biskop (*Pagrus*), jaw of elf *Pomatomus*, otolith of kabeljou (Cape Salmon), biskop or steenbras. Dental plate of Eagle Ray *Wyleobatis* and various other fish" (Goodwin 1938a). During the course of the excavations at Oakhurst it was observed that few fish bones were present in the lowermost deposits suggesting that fewer fish were caught in the earlier periods of occupation. Goodwin did, however, notice an increase in fish remains through the later Holocene levels in the upper part of the sequence, which he related to a change in fishing technique i.e. the introduction of 'fish-traps' (Goodwin 1946). These are rock walls or stone weirs built along the shore to create enclosed areas with walls low enough to be just submerged during high tide. As the tide recedes any fish that has ventured into the intertidal zone where the traps are located may be trapped inside the stone weir (Avery 1975).

The highest counts of fish bone were associated with what was then called the Final Wilton which were the uppermost layers in the site (Deacon 1984). Goodwin believed that fishing became an integral and regular part of the diet of the LSA people whenever coastal resources were exploited (Goodwin 1938a). Since no line-sinkers or even any primitive form of fish hook were found associated with the fish bone, he attributed the increase of fish in the later Wilton levels to the use of these fish-traps.

Many fish bones were also recovered at Klipkop Cave near Hermanus, where the fish were identified as belonging to the genera *Pagrus, Dentex, Sparus* and *Diplodus* by Barnard (Goodwin 1938b). The inadequacy of the description by modern standards reflects the lack of good comparative material available at the time as well as a lesser interest in reconstructing

the diet of prehistoric hunter-fisher-gatherers. With the exception of *Diplodus* these generic names are no longer current.

This early attempt to analyze fish remains has shown that although no quantification was done on the fish bone recovered from these sites, some species were identified and the density of fish remains was noted. It was also suggested that the difference in density in the layers may be related to a change in the technology employed by the inhabitants (Goodwin 1938a, 1938b).

In 1966 Prof. J.L.B. Smith analysed the fish remains from two coastal middens excavated by H.J. Deacon near Storms River Mouth, (Deacon 1970). This was the first systematic analysis and the first counting of all body parts of fish published in South Africa. Although the fish were not interpreted in terms of their importance in the diet, the study showed the potential fish remains had for the interpretation of habitat selection and the possible role sea temperature changes may have had on certain fish species. Smith noticed that large numbers of dassie *Diplodus sargus capensis* were caught by the inhabitants of these sites and suggested that this may be related to cold water upwellings since this species is easily affected by temperature changes (Deacon 1970).

The next site to yield large amounts of fish remains was Nelson Bay Cave (NBC), near Plettenberg Bay, excavated by Inskeep and Klein (Klein 1972a, 1972b; Inskeep 1978, 1987; Deacon 1984). This site revealed a sequence with fish bone from the late Pleistocene through the Holocene. From 1966 to 1980 I analysed the fish remains from this site and developed ways and means to identify the different species from the fragmentary bones usually encountered in archaeological sites. More than 20 000 fish have been identified from NBC and these represent nineteen species (Klein 1972a; Deacon 1984; Inskeep 1987).

The excavations conducted by Klein were restricted to the terminal Pleistocene and early Holocene deposits and focussed on the area towards the interior of the cave where a substantial trench was excavated down to a depth of 2,5 metres. The radiocarbon dates ranged from greater than 40 000 to about 5000 years ago (Klein 1972a; 1972b). Fish bone first appeared in a stratigraphic unit dated to about 11 500 years ago (UW-162 11 505 $\pm$ 110 BP), which contained the upper layers of the Robberg industry, and below this level no fish bone was recovered. The Brown

Stony Loam (BSL), the first layer with fish, yielded only four taxa; white stumpnose *Rhabdosargus globiceps*, dassie *Diplodus sargus capensis*, white steenbras *Lithognathus lithognathus* and galjoen *Coracinus capensis* which comprised about 14% of the total fish identified at the site (Figure 2:2). The most common species in the lower deposits was first identified as white biskop *Sparadon durbanensis* but later re-examination of the fish bone indicated that the maxillae and dentaries belong to the white stumpnose *Rhabdosargus globiceps*. Although it is possible to separate the two species on the placement of the teeth in the jaw bones (see Appendix B), those which were retrieved from the archaeological samples had lost all teeth which made identification difficult. Re-examination of the bone showed that large numbers of frontals were present. When compared with modern comparative specimens it was clear that all the frontals belong to white stumpnose and not white musselcracker. The white stumpnose frontals become fused and robust in adults whereas those of the white biskop stay porous and never become heavy or fused.

The size of the white stumpnose mandibles varied from layer to layer and show that no small ones were caught in the earlier layers. The mandibles were measured and gave the following results. Before 10 000 BP all the white stumpnose caught were large (mean size 340 mm), both large and small were found between 10 000 and 8500 BP (mean size 270 mm) and only small ones after 8500 BP (mean size 160 mm) (Figure 2:3). As the size of the white stumpnose decreased the number of different species increase.

In the layer dated to 9000 BP called Brown Soil Below Jake (BSBJ), the number of taxa increased from four to ten and species such as yellowtail *Seriola lalandi*, black musselcracker *Cymatoceps nasutus*, elf *Pomatomus saltatrix*, and kob *Argyrosomus hololepidotus* made their first appearance in the sequence. Hereafter, these taxa remained relatively common throughout the remainder of the sequence.

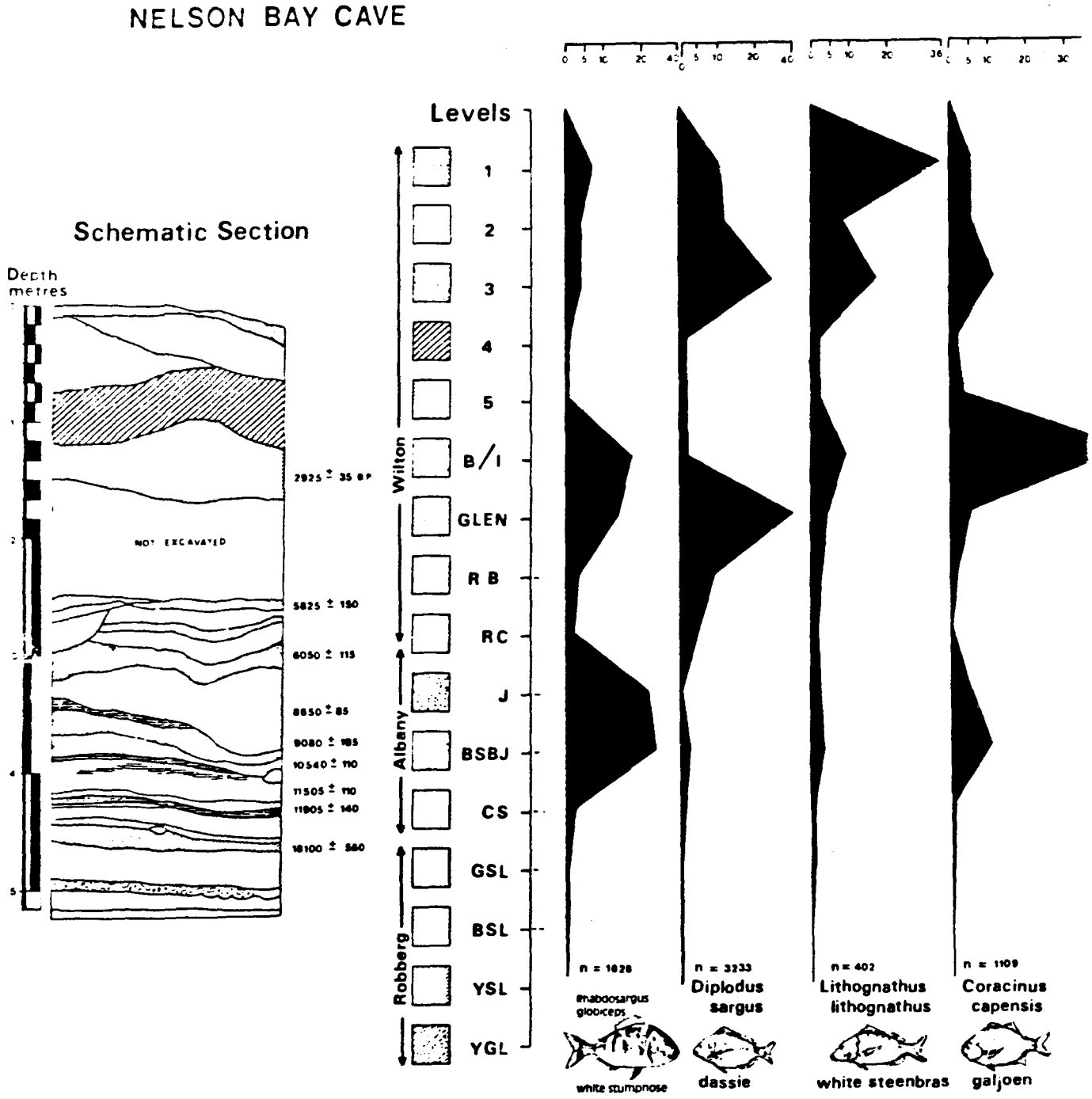


Figure 2:2. The distribution of identified fish in the lower deposits of NBC.

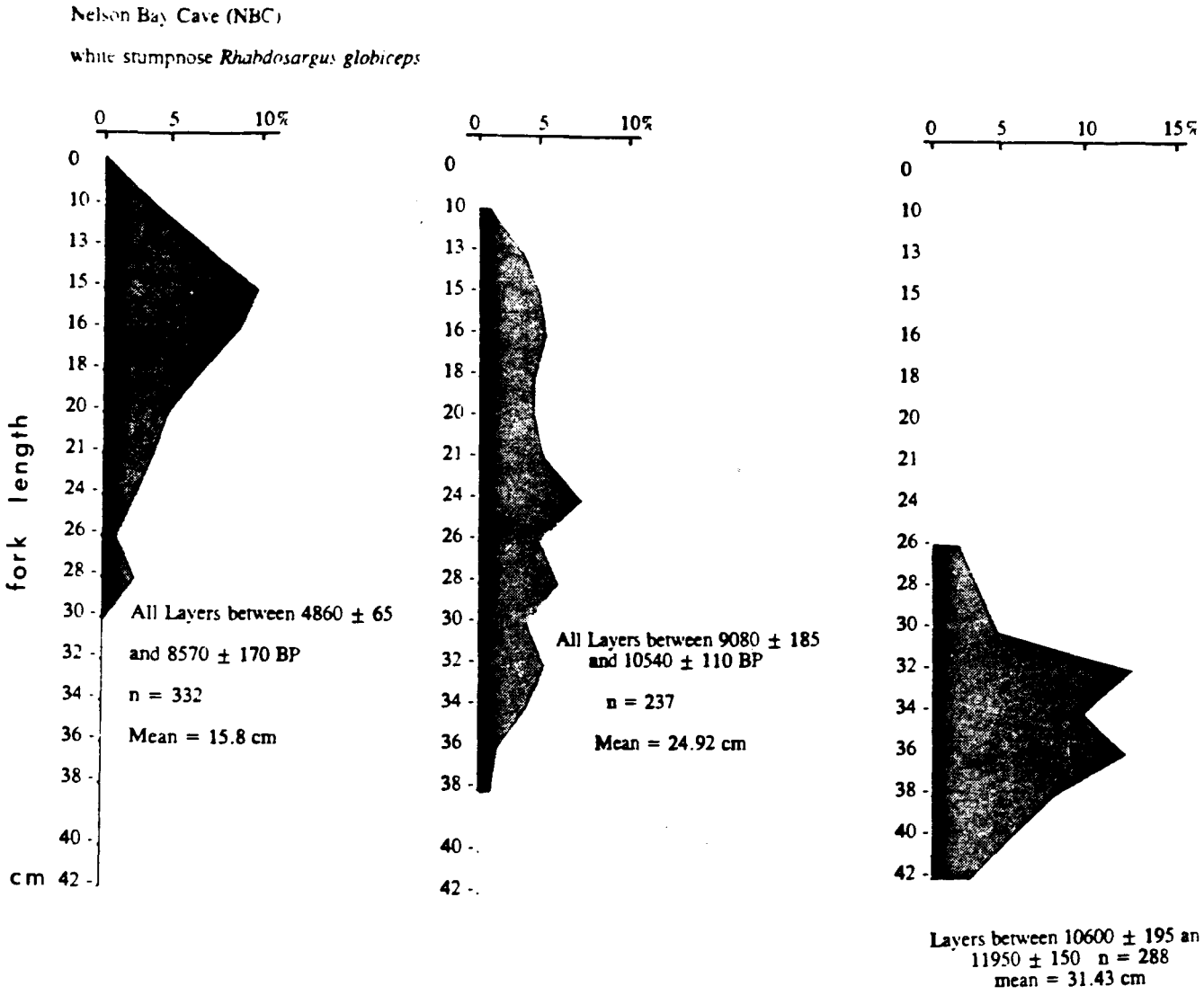


Figure 2:3. The size distribution of white stumpnose *Rhabdosargus globiceps* in the lower deposits of Nelson Bay Cave.

From about 8500 BP onwards, smaller fishes such as sand steenbras *Lithognathus mormyrus*, zebra *Diplodus cervinus hottentotus*, hottentot *Pachymetopon blochii* and carpenter *Argyrozona argyrozona* were present. This introduction of smaller fish in the sequence may be related to a change in fishing technique from predominantly line fishing to intertidal fish trapping or net fishing (Figure 2:4) since most of them are difficult to catch with hand lines.The deposits which date from 5000 years ago to the present were excavated by Inskeep from 1965-1972 (Inskeep 1987). More than fourteen thousand fish representing nineteen species were identified on premaxillae, dentaries, basioccipitals and atlas bones as well as on otoliths (Poggenpoel 1987). What may be of particular significance is the appearance of fish such as southern mullet (harder) *Liza richardsoni*, strepie *Sarpa salpa* and klipfish (of the family *Clinnidae*) after 5000 years ago. Two of the above (southern mullet and strepies) are commonly taken in large numbers by fishermen in fish-traps along the south-east coast (Avery 1975). The appearance of these smaller fishes in the sequence may indicate the introduction of a different technique such as a change from handline fishing to trapping as mentioned earlier (Goodwin 1946).

In the earlier deposits excavated by Klein which date to 9600 years ago large numbers of fish gorges were associated with the fish bone whereas almost none were recovered from the uppermost layers in the cave. Angling may have played an important role in procurement in the upper layers since eleven of the most common fish caught are caught most often with rod and line from rocky points or gullies. Several grooved stones were found associated with the fish bone in units dated after 5000 years ago, their size (average weight 20 gm) suggests that they were used as line sinkers as part of an angling system.

With the exception of three possible bone fish gorges no other artefact that looked like a fish hook was found to replace the large number of fish gorges present in the earlier deposits excavated by Klein (Inskeep 1987). Some of the other fish such as white steenbras and southern mullet are clearly more difficult to catch with lines. The methods which were probably used for catching them are netting, trapping or spearing.

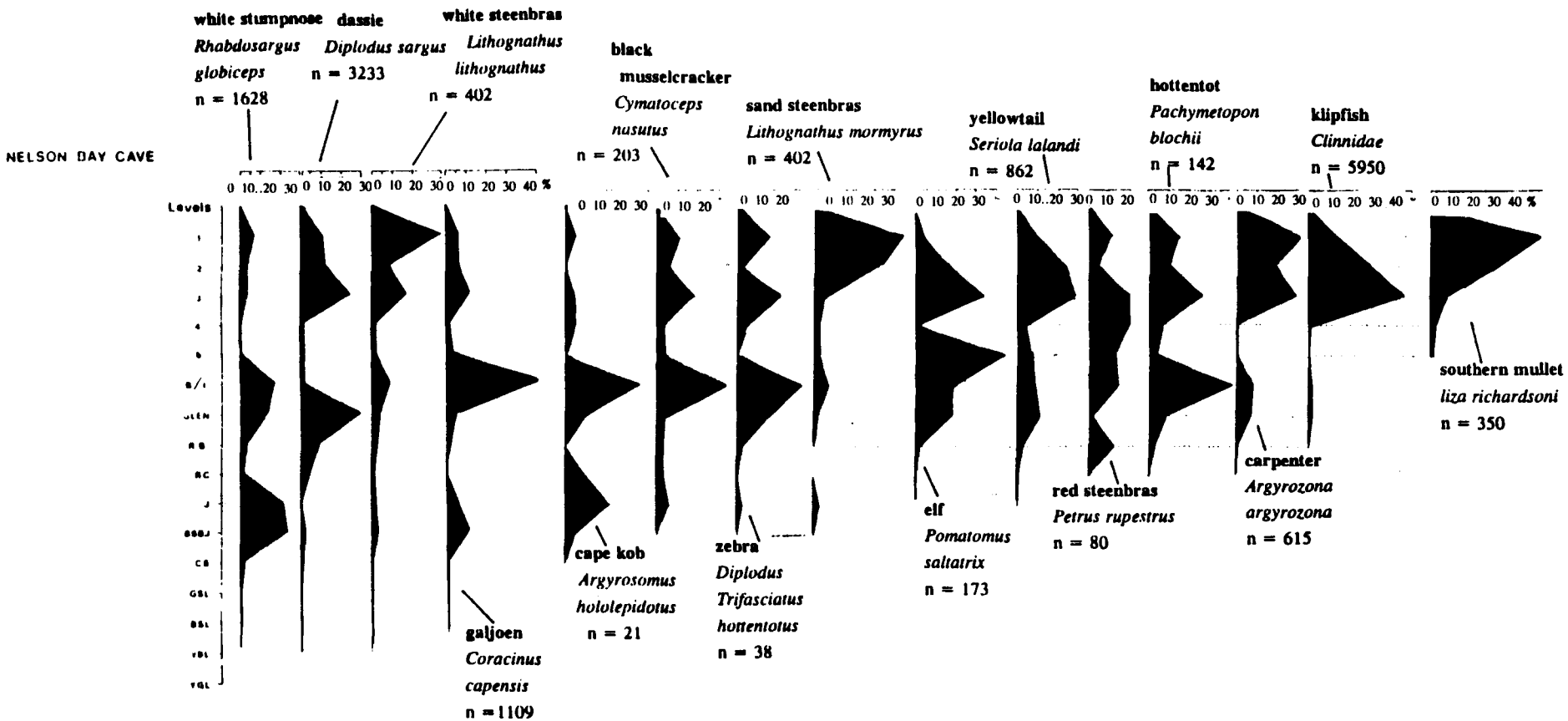


Figure 2:4. The distribution of identified fish taxa in the Nelson Bay Cave sequence (after Klein 1972; Inskeep 1987).

In searching for explanations for these changes it is natural to consider the role of environmental change as well as the evidence for changing fishing equipment from the relevant artefact assemblages. The shift from four species in the terminal Pleistocene to more than ten in the early Holocene would seem not to be connected with changes in technology but rather be related to changes in sea level and temperature. The extra species found in the early Holocene deposits are all warm water fishes. Shackleton (1973) also suggested (on the basis of isotopic analysis of sea shells) that an increase in sea temperature of up to 2°C or 3°C had occurred, roughly at the same time as the increase in fish species (Klein 1972a). The first appearance of fish in the site is associated with fish gorges but these disappear soon thereafter when the number of taxa increase. The introduction of fish such as southern mullet, strepies and klipfish, after 5000 BP may, however, be related to technological change, since evidence has shown that these species are best caught with a mass trapping technique, such as fish trapping with fish-traps or nets rather than with handline and sinker (Avery 1975; Inskeep 1987).

The upwelling of cold water is a characteristic feature of the south-east coast and occurs at least once and sometimes as many as five times a year (Smith 1953; Cohen 1993). It is tempting to conclude that the high numbers of fish present in some units may reflect the occurrence of such events but the absence of fishes such as the spotted grunter *Pomadasys commersonni*, which are easily stunned during cold upwelling, as well as a complete absence of tropical forms may argue that such episodes may not have been heavily exploited by the occupants of NBC. Alternatively, it is possible that whenever cold upwellings did occur, only the species normally caught by the inhabitants were selected for consumption.

The number of identified taxa in the site is nineteen. The distribution of the species in the site shows that all taxa do not occur throughout the sequence. In the lower deposits Brown Stony Loam (BSL), Grey Stony Loam (GSL) and Crushed Shell (CS) only four taxa are represented, whereas eight are associated with the next layer, BSBJ and fifteen are associated with the later Holocene deposits. The fish sample shows a broad pattern of increase through the sequence from 11 500 to 5000 BP and then a decrease from 5000 to 3000 BP. The largest amount of fish were caught between 3000 and 1930 BP with a slight increase of some species from

1930 to 455 BP. On the whole the mid Holocene deposits contained more than twice as many individuals as the early Holocene deposits. The upper Holocene layers have more than eight times the amount of fish as the early Holocene. It is possible that the great difference in fish numbers may be due to the volume of deposit excavated. Inskeep excavated more than fifty metre squares which contained the middle and late Holocene deposits, whereas Klein only excavated eight square metres of the lower deposits that contained the late Pleistocene and early Holocene layers. Although the volume of deposit excavated in the two excavations may have a direct affect on the MNI of different taxa, it appears to have had little influence on the presence or absence of taxa in each stratigraphic layer.

2.1: Conclusion

The analysis of fish assemblages before 1960 concentrated mainly on the identification of different taxa and little attention was paid to the importance of fish in the diet, or the possibility that it may have any potential to help interpret changes in past environments and habitat selection. During the early 1960s the analysis of fish remains from the SRM sites conducted by Smith gave us the first glimpse of what can be gained by conducting a proper analysis on fish remains. He separated cranial bone from post cranial bone and also identified body parts as far as possible. By using only maxillae and dentaries to arrive at an MNI his approach did not allow for the identification of species that might have low mandible counts in the samples.

Since the sites were located near the Storms River mouth, I was curious as to why so few estuarine species was identified (Deacon 1970). I then rexamined the fish bone from SRM1 site and using the basi-occipital and atlas vertebrae bones, identified the presence of southern mullet *Liza richardsoni* which was not identified by Smith and also increased the overall sample from 9 to 13 taxa (Figure 2:5a & b). This exercise has shown that all bones in a given sample should be considered for species identifications, because any resulting misrepresentation of species may have an adverse effect on the interpretation of habitat exploitation or seasonal behavioural patterns of the species in question (Poggenpoel 1984).

STORMS RIVER MOUTH CAVE SITE 1

	Premaxilla		Dentary		Minimum No.	
	L	R	L	R		
Pomatomus saltator			1	2	2	
Rhabdosargus sarba			4	1	4	
Diplodus sargus	6	3	2		6	
Diplodus trifasciatus	1	1	2		2	
Chrysoblephus laticeps	2	7	2	3	7	
Chrysoblephus gibbiceps		1	1		1	
Lithognathus lithognathus			1	1	1	
Lithognathus mormyrus			1	2	2	
Pachymetopon grande	1				1	26

Figure 2:5a. The identification of fish taxa from SRM 1 by J.L.B. Smith.

Storms River Mouth Cave 1. (SRM1)

element Species	RPM	LPM	RD	LD	RM	LM	Tot
white stumpnose *Rhabdosargus sarba*	4	7	2	6	4	1	7
blackmussel cracker *Cymatoceps nasutus*	5	1	4	1	0	1	5
white steenbras *Lithognathus lithognathus*	0	2	1	2	3	0	3
blacktail *diplodus sargus capensis*	3	5	1	2	0	0	5
elf *Pomatomus saltatrix*	0	0	2	0	0	0	2
galjoen *coracinus capensis*	0	0	1	2	0	0	2
bronze bream *Pachymetopon grande*	1	1	0	0	0	0	1
carpenter *Argyrozona argyrozona*	0	1	1	1	0	0	1
sand steenbras *Lithognathus mormyrus*	2	1	1	1	1	0	2
maasbanker *Trachysurus trachysurus*	0	0	1	0	0	0	1
klipfish *Clinnidae*	0	0	1	1	0	0	1
Zebra *Diplodus trifasciatus hottentotus*	1	1	0	2	0	0	2
red stumpnose *Chrysoblephus gibbiceps*	1	0	0	1	0	0	1
sea catfish *Arius feliceps*	0	0	1	0	0	0	1
southern mullet *liza richardsoni*	1	2	1	3	0	0	3
Total	18	23	16	22	8	2	38

Number of southern mullet counted on basi-occipitals = 39
Number of sea catfish counted on hayo-ethmoids = 6
Total number of fish counted at SRM 1 is 83

Figure 2:5b. The identification of fish taxa from SRM 1 by C.A.Poggenpoel.

This more thorough approach to analysis started a new dimension in fish identification which included the use of all fish body parts to arrive at MNI and NISP counts as used for other mammalian fauna in archaeological samples. Later analysis of fish assemblages from NBC made us aware of the potential fish remains had for the interpretation of past climatic changes, and of changing fishing technologies through the late Pleistocene and Holocene. In recent years the research on fish in prehistoric contexts has become multi-disciplinary and includes a number of scientific techniques that can be used to help interpret age and size profiles, the utilisation of different fishing habitats as well as the changes in temperature that can be related to changes in environments exploited by prehistoric groups in the past.

CHAPTER THREE

FISH ENVIRONMENTS

3.1: The Southern Oceans and the Benguela Current

Southern Africa is framed by two of the world's largest oceans, the Indian Ocean on the south and south-east coast and the Atlantic Ocean on the west coast. Two major Current systems influence the climatic conditions that prevail in southern Africa, the Agulhas Current that carries warm tropical waters south-westwards past the east and south-east coast and the Benguela Current that flows northwards past the south-west and west coast, fed partly by the West Wind Drift which flows from west to east in latitudes 40°S - 60°S (Smith 1953; Grindley 1969; Branch & Branch 1981; Cohen 1993), (Figure 3:1).

In warm coastal waters of the south-east coast, a great diversity of life forms exist due to the variety of environmental niches which create favourable conditions for specialization, development and production of different species (Smith 1953). Although this is true for the Agulhas Current, it still does not have the vast biomass of marine life found in the Benguela Current and this apparently is due to its low nutrient and oxygen status (Grindley 1969).

The West Wind Drift circulates south of the Cape and flows eastwards. At the Cape the northern sector of the Current is divided, the northern flank flows northwards along the south-west and western shore of the western Cape as the Benguela Current until it turns westwards where it flows into equatorial waters. The Benguela Current originates partly from the Sub-Antarctic Gyral Current and partly from the West Wind Drift.

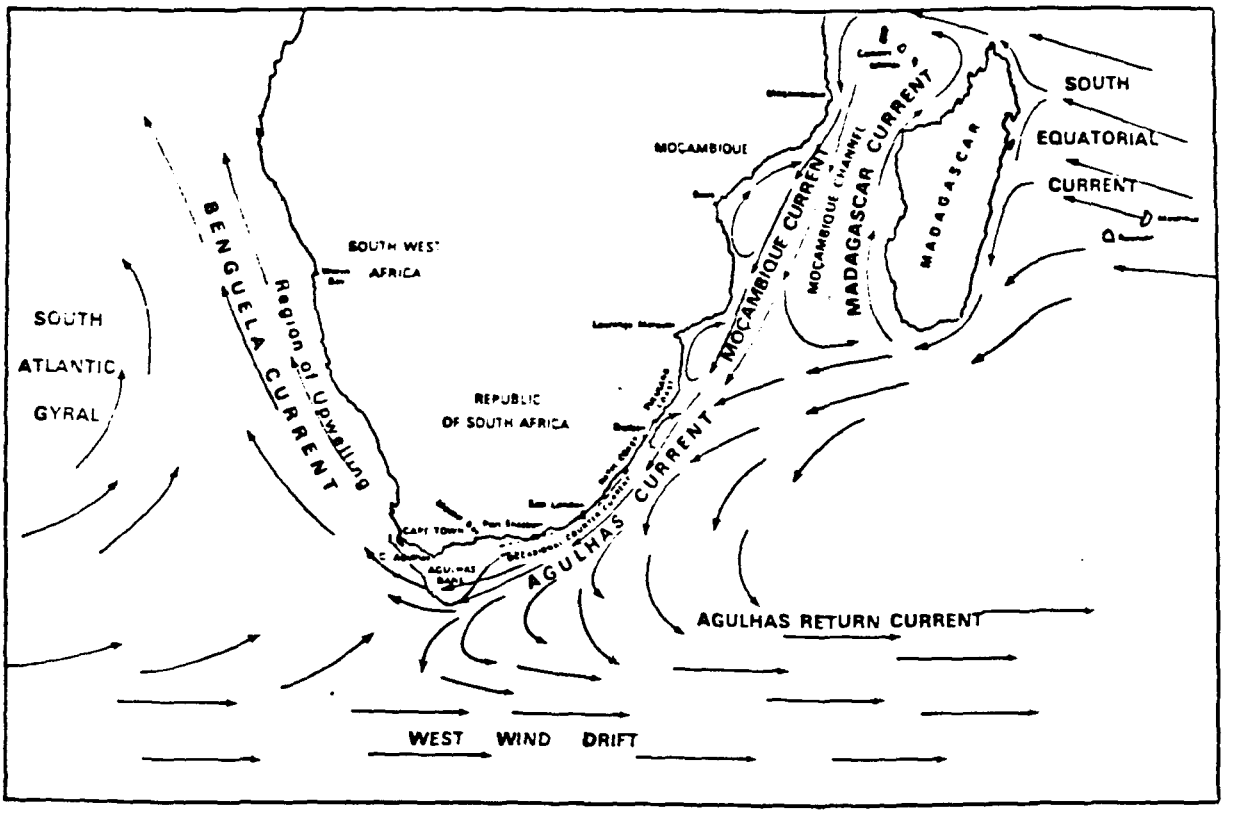


Figure 3.1: Map showing the three major Current systems in the southern Oceans around South Africa (after Grindley 1969).

It is a cold current with an incredible biomass of marine life. More than 90% of South Africa's annual fish harvest is taken from the fishing grounds found in the Benguela Current (Grindley 1969). This abundance of fish life seems to be related to the cold upwelling that occurs off the south-west and west coast. During the summer months the south-easterly wind blows on a regular basis. The action of this strong wind on the sea's surface causes a surface water movement or current to be set up. The water should move in a north-westerly direction but because of 'Coriolis Force' resulting from the earth's rotation it is deflected further west and away from the shore. This surface water which has been moved offshore is replaced by cold water that upwells from 200 m and more below the surface and carries an abundance of nutrients which have been transported from the south below the euphotic zone (Stander 1969; Heydorn & Tinley 1980). In this area light does not penetrate and photosynthesis by phytoplankton does not occur, allowing a diversity of nutrients to be stored there. During upwelling the rich nutrients are brought to the surface and support the growth of phytoplankton, which in turn gives a boost to the whole food chain, culminating in a highly productive fishery (Grindley 1969; Branch & Branch 1981).

The distribution of marine life beneath the sea is strongly influenced by the topography of the coast line. The continental shelf, which extends from the shore down to more than 200 m, and the depths of the sea with its submarine mountains which sometimes protrude as islands, have given rise to the abundant littoral flora and fauna in the research area. The continental shelf is most pronounced along the west coast around the southern tip of the sub-continent and between Cape Agulhas and Mossel Bay where it is known as the Agulhas Bank. Here enormous numbers of bottom dwelling fishes have been discovered through deep-sea trawling. On the west coast and on part of the south coast the ocean bed slopes gradually so that fairly shallow water extends far out to sea. This shallow water is ideal for pelagic fishes that spawn offshore.

All bony fishes are dependant on stable temperatures and unexpected cold upwelling can produce temperature fluctuations that they cannot tolerate. The body temperature of fishes tends to be the same as that of the surrounding water in which they live, and if the water temperature changes suddenly, some species may become stunned and be temporarily paralysed.

If the temperature change is maintained for a long period of time, it may cause death. Sea temperatures along the Atlantic coast tend to stay fairly stable throughout the year, ranging between 18°C and 8°C with an average of 12°C (Allanson 1984). During the summer months the water is generally cooler due to increased upwelling. Although cold water through upwelling occurs quite frequently off the west coast, it seldom reaches the shore. When a body of cold water does approach the coast, then both littoral and pelagic fishes tend to seek refuge in the warmer shallow inshore waters and concentrate in vast numbers in lagoons and tidal estuaries.

An oxygen depleted sub-surface current seems to be present some 70 km off the west coast. It consists of an abnormally low content of dissolved oxygen, which falls below the minimum requirements of most marine life (De Decker 1970). Occasionally it rises towards the surface, with the help of offshore winds that drive the surface waters away from the coast, as the oxygen depleted water rises by being carried along the bottom towards the shore, and in doing so it traps marine animals against the shore.

Most such occurrences have been recorded towards the end of summer (De Decker 1970). Very recently an occurrence of this kind was experienced in the St Helena Bay area in the month of February 1994, where many crayfish walked out of the water and at least thirteen species of fish, estimated at approximately 100 tons, died and were washed ashore (pers. obs.). On this occasion the species that was most seriously affected was the southern mullet (harder) *Liza richardsoni*. The water turned black from the large amount of hydrogen sulphate that was released in the water from the decaying animals, hence the name (black tide). All sizes of fish were impacted by the black tide, as well as a large number of cartilaginous fishes. Many of the sparid fishes affected were adult fish that occupy deeper water, suggesting that the oxygen depleted water did not affect only the fishes in the littoral zone.

The Benguela Current has long been recognised as unstable in temperature and most animals have to adapt to temperature variation (Allanson 1984). Temperature fluctuations caused through cold upwellings along the west coast therefore may have an adverse effect on the scope of oxygen isotope analysis on fish remains to separate past seasonal temperatures and paleoenvironments. Warm water can also penetrate the

Benguela Current when prevailing winds of winter from the north-north-west can drive in warmer surface waters from the equatorial region. Further south the warmer east coast Agulhas current may round the Cape with strong south-south-easterly winds causing temperatures to rise to as high as 23°C, circumstances which have caused mass mortalities of cold water fauna in the past. But on the whole, the body of cold water along the west coast prevents the mixing of warm loving fishes from the Indian Ocean and fishes from the coldest part of the Atlantic.

3.2: Fish fauna and habitats

The fish fauna in the Oceans around southern Africa is regarded as as diversified and plentiful as anywhere in the world today, but it is generally believed that since the introduction of modern commercial fishing techniques, the fish populations have become somewhat depleted (Grindley 1969). The number of species recorded from South African waters increases yearly by the discovery of at least one new species every year, and up to 1980 approximately 1325 species had been identified, are made up as follows; Indo Pacific 49%, Endemic 25%, Cosmopolitan 15%, Atlantic 3.0%, Deep-sea 5.5% and Sub-Antarctic 2.5%, and of which 25% are littoral (Smith 1953; Smith & Smith 1966; Day 1969; Grindley 1969; Branch & Branch 1981; van der Elst 1981).

Although many species are highly mobile, some have a strong tendency to inhabit specific habitats. These habitats are mainly occupied by fishes that live in the littoral zone close inshore. The variety of species found in this area goes hand in hand with the number of habitats present in the coastal zone. These habitats and environmental niches are determined by the type of ocean floor topography, wave action, water temperature, plant cover, inshore currents and shelter that can be provided by embayments and rocky shores. Other areas with great potential for housing large numbers of fishes are offshore reefs, sandy beaches, lagoons and estuaries. The only habitat that is not found in the research area is the coral reef. In southern Africa, these are mainly located in the Natal, Zululand, and Mocambique areas where large numbers of tropical fish can be found, of which very few penetrate into Cape waters (Branch *et al.* 1994).

The rocky shore areas are less spectacular then the coral reefs, but offer suitable habitats to a number of important species. The abundant food supply attracts numerous species along the continental shelf and, if the reefs are not too deep, they can provide shelter for many species, of which some are endemic to South Africa. Other reefs deeper than 80 fathoms may house large quantities of bottom dwelling species, as at the Agulhas bank. Large parts of the Cape coastal shore are made up of long stretches of open sandy beaches interrupted by occasional rocky outcrops. Most of the fishes found in these areas are littoral but many pelagic fish enter the surf zone during migration or during the spawning season when they fall prey to local fishermen.

CHAPTER FOUR

THE FISHING HABITATS OF ELANDS BAY AND THE FISH ASSEMBLAGE FROM ELANDS BAY CAVE (EBC)

This chapter and the next introduce the marine inshore and Verlorenvlei fishing habitats in the Elands Bay area and describe the identification of archaeological fish assemblages from four excavated sites in the vicinity of Verlorenvlei. The fish assemblages are used, first, as an alternative way to interpret how sea level fluctuations have affected the nature of the fishing habitats available in the Verlorenvlei system during the late Pleistocene and Holocene. Secondly, the results are used to throw light on the procurement strategies employed by the hunter-fisher-gatherers who utilised these habitats. The actual fishing technologies used are referred to in a later chapter (Chapter Nine).

4.1: The Elands Bay shoreline habitat

The shoreline at Elands Bay is interrupted by two rocky spurs, one at the foot of Baboon Point cliff and the other at Mussel Point. These rocky areas, along with rocks on the southern side of the bay, are the only areas where large black mussel colonies and limpet shellfish can easily be harvested within a radius of five kilometres of the Elands Bay Cave. The rest of the shore is made up of long sweeping sandy stretches north and south of the cave.

The spur of Baboon Point serves as a breaker for the incoming surf and low wave action to the north of the point has created a shallow sheltered bay. In the bay around the point a large kelp forest has developed which creates the kind of environment which is favoured by crayfish, shellfish

and fish. Near the sub-tidal fringe small tidal pools with sea weeds are the preferred areas where juvenile fish congregate. The mouth of Verlorenvlei lies towards the southern arm of the bay where the present channel has a sill of rock at the position of the lower causeway 300 m from the mouth.

When sufficient water is released during the winter months vast quantities of organic matter and nutrients are discharged, which attracts many marine species to the entrance of the vlei. The southern mullet *Liza richardsoni*, flathead mullet *Mugil cephalus*, white steenbras *Lithognathus lithognathus* and white stumpnose *Rhabdosargus globiceps* spawn within the confines of the bay and the fry enter the vlei where they spend most of their juvenile cycle. Wallace *et al* describe the white steenbras and flathead mullet as "species dependent on estuaries during [the] juvenile phase of their life cycle" (Wallace *et al.* 1984: 204), whereas they describe the white stumpnose and southern mullet as "species whose juveniles occur mainly at sea but are also abundant in estuaries" (Wallace *et al.* 1984: 205), an important distinction. Occasionally other species such as kob *Argyrosomus hololepidotus* and elf *Pomatomus saltatrix* enter the vlei system in search of prey but do not reside there for any length of time and in most cases avoid closed mouth systems.

Along the more open sandy shores the heavier wave action continuously disturbs the sandy bottom and exposes various crustaceans, immature bivalves and organic matter which is favoured by fishes such as white steenbras, white stumpnose, kob and sea catfish *Arius feliceps*. The elf, which is a predator, and the galjoen *Coracinus capensis* prefer the open surf and only penetrate into shallow water when the surf is turbulent. For some species Mussel Point has the ideal combination of a kelp forest, large boulders that create crevices and holes in the rocky substrate and a turbulent surf that can dislodge black mussels. These areas are favoured by hottentot *Pachymetopon blochii*, blacktail *Diplodus sargus capensis*, galjoen *Coracinus capensis* and zebra *Diplodus trifasciatus hottentotus*.

4.2: The ecology of Verlorenvlei

The Verlorenvlei is approximately 13.5 km in length and 1.4 km at its widest point. The length of the channel that connects the vlei to the coast is about 1.5 km. The vlei has a mean depth of 2.5 m and at the deepest part

reaches 5 m (Sinclair *et al.* 1986). From Diepkloof farm to just below the Verlorenvlei farm the vlei has been invaded by large reed beds dominated by the Sonqua riet *Phragmites australis* and has silted up as far as Redelinghuys. The course of the river has become even more restricted in recent years by the construction of causeways and bridges by farmers (Grindley & Grindley 1987; Miller 1987).

The Verlorenvlei can be described as a multi-component wetland, though many terms have been used to describe it. In the upper reaches it is a vlei while in the lower reaches it becomes an estuary and in some years with greater seawater input it becomes a lagoon (Heydorn & Tinley 1980; Grindley & Grindley 1987; Miller 1987). By many researchers it is regarded as a coastal lake or blind estuary, as it has intermittent access to the sea. It is located in a drowned valley on the northern side of a line of hills that meets the Atlantic coast at Baboon Point near Elands Bay some 220 km north of Cape Town (32° 18'S, 18° 19'E) (Parkington 1976a; Grindley *et al.* 1982). At present the vlei cannot be regarded as an estuary because most estuarine systems are dependant upon a continuing interchange between seawater, freshwater and evaporation, whilst at Verlorenvlei the input of seawater is only occasional due to the quartzitic sand bar that hampers the interchange (Grindley 1979; Sinclair *et al.* 1986).

Clearly there is some disagreement about the use of terms for the lower parts of small South African river systems such as the Verlorenvlei (Day 1980; Reddering 1980). The important distinction relates to the regularity of interchange between fresh and saltwater bodies, which may be tidal, seasonal or more occasional. Currently the Verlorenvlei is not open to the sea every year but only when rainfall is sufficient to open the mouth, so that it may properly be referred to as a coastal lake or a blind or closed estuary. There may have been times in the past, however, when the system was seasonally open, creating a fully estuarine situation, or when the mouth was sufficiently open to allow tidal conditions to occur. The prehistoric fish assemblages will help to show how Verlorenvlei has changed in the past.

4.3: The modern fish population of Verlorenvlei

Since the Verlorenvlei became a coastal lake the number of marine/estuarine fish entering the vlei system has dropped to only four taxa; white steenbras *Lithognathus lithognathus*, flathead mullet *Mugil cephalus*, southern mullet *Liza richardsoni* and the estuarine round herring *Gilchristella aestuarius* (Parkington 1976a; Grindley *et al.* 1982; Sinclair *et al.* 1986; Grindley & Grindley 1987; Poggenpoel 1987). When the mouth is closed for a year or two, then the number of species declines to only two, flathead mullet and southern mullet (Grindley & Grindley 1987).

The introduction of exotic species by the Department of Nature and Environmental Conservation during 1967 and 1968 has disturbed the balance of the natural fish population in the Verlorenvlei. Introduced species such as the carp *Cyprinus carpo* and Mozambique tilapia *Oreachromis mossambicus* are dominating the vlei system and prey heavily on most other small fry. The small mouth bass *Micropterus dolomieu*, the large mouth bass *Micropterus samoides* and the tench *Tinca tinca* are present but in smaller numbers. The banded tilapia *Tilapia sparrmanii* has been found only in the upper reaches of the vlei and river, possibly due to its low tolerance of saline conditions (Sinclair *et al.* 1986). Indigenous freshwater species present in the Verlorenvlei system include the Cape kurper *Sandelia capensis*, Cape galaxias *Galaxias zebratus* and the Berg River redfin *Barbus bergi*. Most of these species are not exploited by people but are integral to the food web and are preyed upon by larger fish species and birds.

4.4: Elands Bay Cave (EBC)

Over the past 25 years the Department of Archaeology at the University of Cape Town has been involved in a major archaeological programme under the supervision of John Parkington on the west coast. This research has led to the excavation of a number of archaeological sites which have yielded large quantities of fish remains. The sites are situated near a small fishing village called Elands Bay, some 220 km north of Cape Town (Figure 4:1).

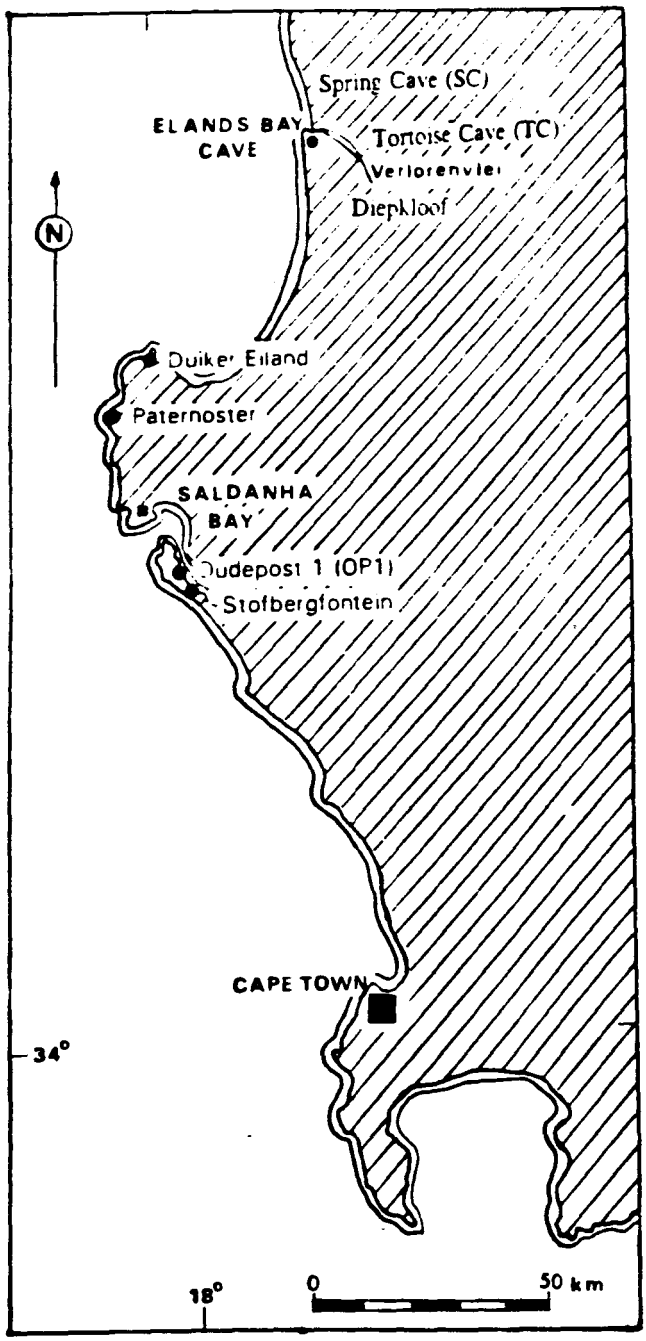


Figure 4:1. The location of Elands Bay Cave and other excavated sites with fish bone assemblages along the west coast, south-western Cape.

On returning from a rock art trip to the Cederberg in the late 1960s, Jalmar Rudner took John Parkington and myself to visit a large cave discovered near Elands Bay (called 'Elands Bay Cave'). After inspection it was decided that there was enough *in situ* deposit in the site to warrant an excavation. The site is located on the sea facing cliff of Baboon Point just south of the mouth of Verlorenvlei on the Atlantic coast of South Africa. The cave is about 40 m above sea level, faces in a north-westerly direction and has a surface area of at least 120 m^2. The cave mouth is about 13 m wide and the height of the opening was probably about 10 m before it was filled with occupation debris. Excavations began in November 1970 and after 20 weeks of digging, the fieldwork was completed in 1978. Excavations were directed by John Parkington, myself and Peter Robertshaw and covered an area of 92 m^2 down to a maximum depth of 2.5 m. The site was chosen because it promised a deep sequence and, since part of the deposit had already been disturbed by people stationed in the radar installation during the Second World War, some spillage from a section in the front of the cave revealed good preservation of bone, plant remains and shellfish which suggested that an excavation towards the interior of the cave might reveal substantial *in situ* deposits.

The irregular sections were cleaned up, straightened and then used as a reference section for the removal of the natural stratigraphic units across the undisturbed area of the cave. The deposits were removed separately in one metre squares and dry sieved through 3 mm and 12 mm sieves at the site. Stone, bone, shell and plant materials were sorted and bagged separately on site and transported to the University of Cape Town for further analysis. The extent of excavations in the following seasons revealed a stratigraphic sequence of deposits extending back beyond 40 000 years BP, of which the last 11 000 years represents coastal exploitation (Parkington 1972, 1976a). The sequence is interrupted by three non-conformities. The absence of occupational deposits between 17 800 - 13 600 years BP may be related to global shifts in sea level since the same hiatus have been noticed at other deep cave sequences in South Africa. At Nelson Bay Cave (Klein 1972a; Deacon 1978, 1984; Inskeep 1987), Boomplaas (Deacon 1979, 1984), Apollo 11 Cave (Wendt 1976) and Sehonghong (Carter & Vogel 1974; Carter 1978; Carter *et al.* 1988), there are few dated horizons in this time period.

Recently a reconstructed stratigraphic matrix for the cave deposits has made it possible to rectify earlier stratigraphic problems and updates all previous descriptions of, or references to the stratigraphy and dating of the site (Parkington 1976a, 1976b, 1977, 1980, 1981; Butzer 1979; Miller 1981, 1987; Poggenpoel 1987). The deposits have been grouped into packages marked one to twenty three on the basis of stratigraphic association, content and radiocarbon dates (Appendix A). This in turn has allowed for greater precision of the chronological placing of the stratigraphic units and greater flexibility for an analytical approach (Figure 4:2).

The character of the deposits in the terminal Pleistocene changes from sandy loams to loams with a high density of marine fauna that eventually give way to shellfish dominated units or shell middens. More than 45% of the deposits removed from the cave fall in the time period from 13 600 to 8000 years BP, which contains archaeological material accumulated across the Pleistocene/Holocene boundary. This would imply that the cave was more regularly occupied during this period than at any other time. The majority of fish bone also comes from this time. The implications are that although large scale landscape loss occurred through the terminal Pleistocene rise in sea level, the proximity of the coast presented local opportunities for increased marine exploitation from the site.

At the last glacial maximum the sea level would have been at least 120 m below present sea level, and would have exposed a coastal plain as wide as 30 - 40 km west of Elands Bay. The inference is that the local vegetation included substantially more grass than at present, which would have suited the larger grazing animals. The exposed geology would have consisted mainly of Malmesbury shale-derived soils which are suitable for grassy plant communities such as those evident in the Swartland area further south and east, in areas where the soils have not been cultivated recently.

Smaller browsing bovids are relatively rare in this time period, although large numbers of tortoise carapace and ostrich egg shell pieces are present, which is suggestive of open plain conditions. A dramatic increase in marine elements is visible in the faunal samples between 11 000 and 9000 years ago, associated with the disappearance of the large grazers and domination by small browsing bovids such as steenbok, grysbok and duiker.

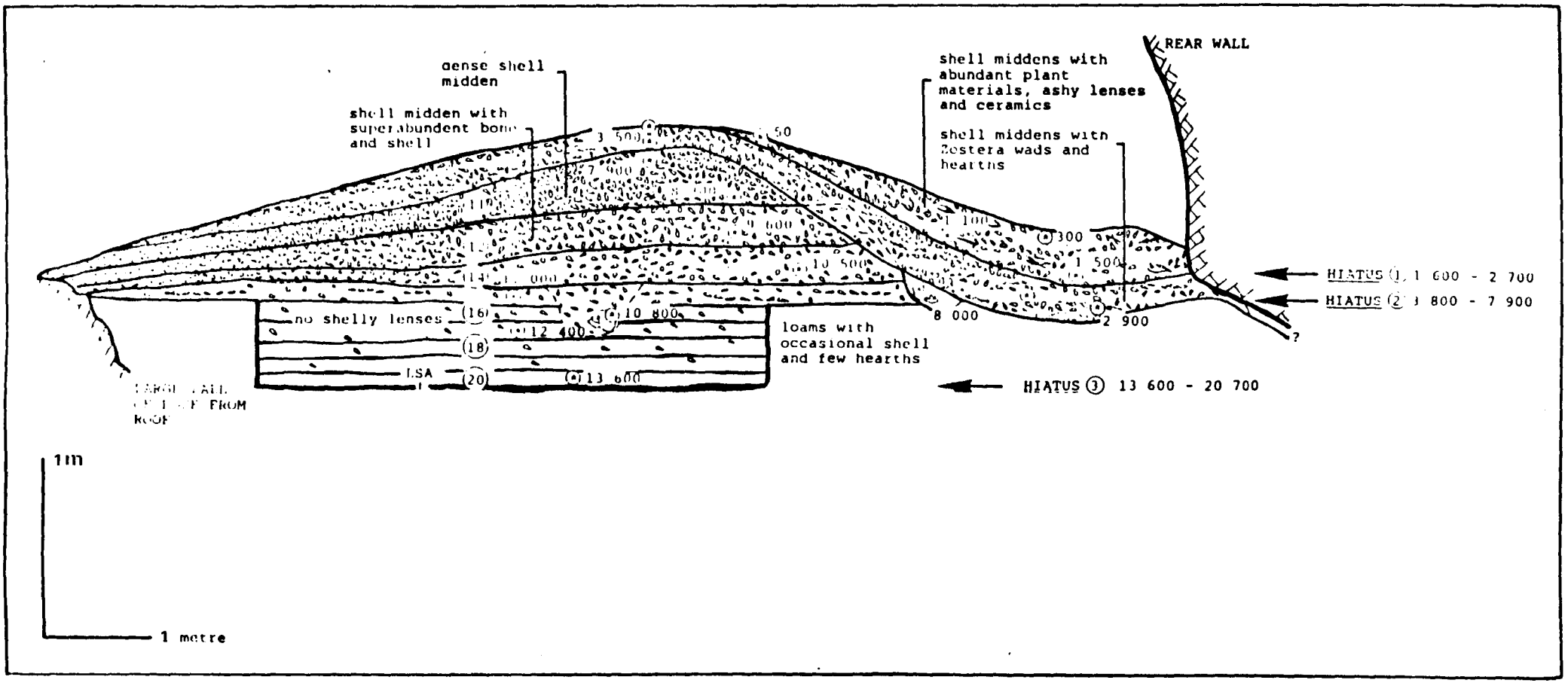


Figure 4:2. Shows the stratigraphic sequence of Elands Bay Cave (after Parkington 1996 SARU Report).

One of the more interesting changes in the mammalian faunal sample is the presence of large grazing forms such as *Equus capensis* prior to 9000 BP, but soon thereafter at the end of the Pleistocene this species became extinct (Klein 1980, 1984). The frequency of tortoise bone drops abruptly after 9000 BP which may reflect the disappearance of the terrestrial catchment to the west of the site through a rise in sea level. On the other hand the visibility and abundance of tortoises seems to be more prominent in spring and summer than during the winter months and the decrease in tortoise bone may reflect a change in site scheduling. There is also a marked increase in the frequency of very young, possibly newborn, steenbok or grysbok (genus *Raphicerus*) about 10 500 years ago. The timing of births among modern animals, although bimodal, shows peaks in autumn and spring in the south-western Cape, and therefore may support the hypothesis for site rescheduling at this time.

During the second hiatus in the occupation of the site from 7900 to 4300 years ago the coast experienced the final rise in sea level up to 3 m above present level (Tankard 1976; Parkington 1980; Miller 1981, 1990; Yates *et al.* 1986; Jerardino 1993; Miller *et al.* 1993). This rise in sea level not only effected changes in the configuration of the Verlorenvlei, making it permanently open to the sea, but also coincides with a period of human non-use at a number of sites in the vicinity of Elands Bay (Parkington 1976a; Robey 1984). The absence of occupational debris may reflect changes in the climatic conditions which might have impacted the freshwater sources and shellfish populations on a local scale. During this period the site also experienced the largest amount of burrowing by small animals. The faunal sample also shows a dramatic increase in small animals such as dune mole rats which, according to Klein & Cruz-Uribe (1987), may be due to eagle owl predation. The absence of people during this period would have made certain parts of the cave attractive as roosting spots, although there are no large accumulations of owl pellet material here.

After the second hiatus, occupation resumed at around 4300 years ago when two important changes in site usage occurred. A series of basins were excavated by the inhabitants around the back wall of the cave, which were filled with ash and shell lenses. The abundant plant materials include terrestrial and estuarine grasses, such as the eelgrass *Zostera capensis*, that

may have been used as bedding. Occupation seems to have shifted towards these basins with most of the fire-places being concentrated in the rear of the cave. A number of post holes were located in the basins as well as in the mound in front. The presence of the post holes may imply that the mouth of the cave was shielded off to keep the cold or windy weather at bay. The third hiatus in occupation represents a much shorter spell between 3200 and 1700 years ago. Similar gaps can be seen at other Verlorenvlei sites, such as Tortoise Cave (TC) between about 3500 and 1700 years ago and Spring Cave (SC) between about 2900 and 1100 years ago (Buchanan 1988; Parkington *et al.* 1988; Jerardino 1993; Miller *et al.* 1993; Parkington in prep.).

The absence of occupation in rock shelters and caves does not mean that people were not present along the coast, but rather that open sites were occupied more often than caves.

A series of very large 'megamiddens' have been located along the shore, which date fairly neatly to the gaps found in the cave occupation histories. Some recent thinking on the interpretation of the open middens (Henshilwood *et al.* 1994) suggests that the megamiddens are possibly the residues of mussel drying with very little evidence of other activities. After the shellfish have been dried, they may have been transported to other sites inland for later consumption (Henshilwood *et al.* 1994).

When occupation resumes after this hiatus the presence of plant material is noticeable. Until about 1600 years or so ago large amounts of eelgrass *Zostera capensis* are visible, which soon give way to other plant residues, mainly made up of twig fragments, terrestrial grasses, corm casings, seeds of the skilpad bessie *Nylandtia spinosa* and other shrubby leaves. After about 1600 years ago these deposits are associated with ceramics and domestic stock (Sealy & Yates 1994). The replacement of *Zostera* with terrestrial grasses as bedding material may indicate changes in the conditions of the vlei. *Zostera* is a grass that requires open estuarine conditions to flourish and the replacement of *Zostera* by twigs and terrestrial grasses in the last 1600 years as bedding materials is taken as an environmental signal, which points to the closure of the Verlorenvlei and the formation of coastal lake conditions at Elands Bay.

4.5: Stratigraphy

The stratigraphically associated deposits and dated layers have been placed in a series of packages and pulses, packages marked one to twenty three and pulses labelled A - G (Parkington in prep.; Appendix A). The packages marked one to nineteen and pulses A - D will be addressed here, in relation to the fish assemblages. Pulse D relates to the Terminal Pleistocene occupations which are sandwiched between the two hiatuses 17 800 to 13 600 years ago at the bottom and 7910 to 4320 years ago at the top. At the bottom of this pulse packages seventeen, eighteen and nineteen are dated to between 11 070 and 13 600 years, and mark the first appearance of fish in the sequence. There are very few other marine elements associated with the fish bone, which may be of some environmental significance.

Geomorphological evidence gathered by various researchers indicate that during the accumulation of archaeological deposits placed in packages seventeen, eighteen and nineteen, the coastline was more than 10 to 15 km to the west of its present position (Butzer & Helgren 1972; Tankard 1976; Butzer 1979, 1984; Miller 1981, 1987). With the coast that far to the west, the configuration of Verlorenvlei would have been very different from today, and a freshwater stream would have flowed through the valley some two kilometres north of Elands Bay Cave. This is clearly an issue to which the number and kinds of fish species in the deposits is directly relevant.

When the first lenses of shellfish appear in the sequence about 11 000 years ago, they are dominated by various limpet species, particularly *P. granatina* and *P. granularis*. This particular pattern of shellfish exploitation is not fully understood but may be related to site scheduling. As pointed out earlier, occupation may have taken place during the summer months before 9600 years ago, because modern observations suggest that red tide episodes, which affect the filter feeding mussels but not the *Patella*, are more common during summer. Such episodes may have been avoided by the prehistoric inhabitants if shellfish were exploited during the summer months. Between 9600 and 8000 years ago there is a considerable shift in the shellfish composition. The black mussel *Choromytilus meridionalis* first appear in low numbers and later become equal in frequency to *Patella* and soon thereafter dominate the shellfish samples. The increase in mussel

numbers after 9600 BP may reflect a change in the timing of site occupation from summer to the safer spring and winter months which would have resulted in the harvesting of the vast mussel populations on the isolated rocky points.

4.6: Fish assemblage

More than 55 000 fish bones have been analyzed, representing fifteen taxa (Table 4:1). The species identifications were made on a number of different bones, i.e. premaxillae, maxillae, dentaries, basi-occipitals, atlas vertebrae and otoliths. Many of the sparid fishes are best represented by premaxillae and dentaries, since their jaw bones are sturdy and survive well in the deposits. In contrast, the jaws of the Mugilidae are very fragile and disintegrate very quickly, with the result that they are best represented by basi-occipitals and atlas vertebrae. The highest number of individual counts for sea catfish *Arius feliceps* have been achieved by counting and weighing the number of sea catfish otoliths represented in each unit. It was decided to weigh the otoliths since it is very difficult to distinguish between left and right sea catfish otoliths. The otoliths are identical in shape and size. Otoliths of similar weight were grouped in pairs so that each pair represent one specimen. The remaining unmatched otoliths were considered to represent single individuals. In this way an MNI was generated for the sea catfish present in the site.

4.7: Preservation and discolouration of fish bone

The preservation of fish bone in the archaeological record is to a large extent determined by the type of site and the kind of associated material. In cave sites, for example, the deposit is protected in an enclosed space. The deposit can be either alkaline or acidic and will affect the preservation of faunal elements, including fish bone. In open sites organic materials are exposed to natural elements, become sun bleached and fragment to unidentifiable pieces.

At the same time preservation of faunal elements in assemblages can be influenced by human or animal behaviour.

ELANDS BAY CAVE

IDENTIFICATIONS OF FISH TAXA

STRATIGRAPHIC PACKAGES	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19		TOTAL
white steenbras	1	1	1	23	34	10	5	31	59	32	22	2	714	22	28	5	2	0	0	MNI	992
Lithognathus lithognathus	1	2	4	112	147	39	17	145	276	176	108	6	3392	77	140	15	3	0	0	NISP	4660
white stumpnose	0	0	0	4	2	7	2	4	6	20	5	6	160	6	7	3	0	0	0	MNI	232
Rhabdosargus globiceps	0	0	0	10	5	33	8	15	25	74	27	17	160	8	25	8	0	0	0	NISP	415
southern mullet	0	0	0	11	11	4	1	3	7	2	15	6	184	44	161	3	2	1	1	MNI	456
Lisa richardsonii	0	0	0	13	32	8	1	5	13	2	29	11	300	74	161	4	3	1	1	NISP	658
flat head mullet	1	1	2	4	1	4	1	4	3	0	4	0	1	10	4	0	0	0	0	MNI	30
Mugil cephalus	1	2	5	27	3	17	4	12	16	0	5	0	1	10	4	0	0	0	0	NISP	107
dassie	0	0	0	0	1	5	2	1	8	2	1	0	2	0	0	1	0	0	0	MNI	23
Diplodus sargus capensis	0	0	0	0	3	10	3	2	26	4	5	0	2	0	0	1	0	0	0	NISP	56
elf	0	0	0	2	1	2	0	0	1	0	0	0	0	0	0	1	0	0	0	MNI	6
Tomatomus saltatrix	0	0	0	4	4	2	0	0	2	0	0	0	0	0	0	1	0	0	0	NISP	13
kabeljou	0	0	0	1	1	0	0	0	0	3	1	0	32	1	0	0	0	0	0	MNI	40
Argyrosomus hololepidotus	0	0	0	1	2	0	0	0	0	7	1	0	64	1	0	0	0	0	0	NISP	76
snoek	0	0	0	0	1	0	0	2	1	0	0	0	0	0	0	0	0	0	0	MNI	4
Thyrsites atun	0	0	0	0	1	0	0	3	1	0	0	0	0	0	0	0	0	0	0	NISP	5
hottentot	0	0	0	1	0	0	1	3	3	0	0	0	0	0	0	0	0	0	0	MNI	4
Pachymetopon blochii	0	0	0	1	0	0	1	3	5	0	0	0	0	0	0	0	0	0	0	NISP	4
kingklip	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	MNI	6
Xiphiurus capensis	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	NISP	8
cat fish	0	0	0	0	0	0	0	0	0	1	1	0	13	0	0	0	0	0	0	MNI	15
Arius feliceps	0	0	0	0	0	0	0	0	0	1	1	0	26	0	0	0	0	0	0	NISP	28
strepie	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	MNI	1
Sarba salpa	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	NISP	1
zebra *Diplodus cervinus*	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	MNI	1
	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	NISP	1
west coast steenbras *Lithognathus aureti*	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	MNI	1
	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	NISP	1
galjoen *Coracinus capensis*	0	0	0	0	0	0	0	0	2	0	0	0	1	0	0	0	0	0	0	MNI	3
	0	0	0	0	0	0	0	0	2	0	0	0	1	0	0	0	0	0	0	NISP	3
TOTAL	2	2	3	16	52	32	12	49	41	61	51	14	1107	73	200	13	4	1	1	MNI	1814
	2	4	2	168	197	109	34	186	255	265	178	34	3945	170	330	29	6	1	1	NISP	5233

Table 4:1. Shows the distribution of fish taxa in the EBC sequence.

The activities, for example, of processing, eating, discarding and cooking of food by people and the collecting, consumption and gnawing of bones by carnivores are sometimes responsible for the absence or presence of certain elements in different parts of the site (Stewart 1989). The bones which are recovered through excavation are, thus, only a partial reflection of what the dietary package entailed and should be expressed as such.

At EBC the preservation of fish bone is very good throughout the site. In the uppermost packages fish elements are rather infrequent and whenever they were encountered some bones were encrusted with halite crystals, which may have helped to preserve them. In package four the fish elements are light brown in colour and in some units are very dry. The dryness of the bones made them very fragile and some have not survived the sieve, since they disintegrate easily when exposed to the sun for any period of time. In the laboratory many of the bones could not be analysed in the normal manner and some had to be submerged in a solution of diluted cold glue to stop the bone from fragmenting. In package six the colour of the fish elements was still light brown, but in some instances they were covered with a thin film of white gypsum. Large quantities of gypsum have been found inside *Patella* and black mussel shells and whenever faunal material was found amongst the shellfish, the bone became coated with a thin layer of gypsum. Occasionally some faunal elements showed small patches of manganese staining which may be due to manganese dioxide being absorbed from the deposit. In package thirteen the colour of the bone changed completely from light brown to dark brown as well as becoming 'greasy' in nature. I am not sure if the bone in these units absorbed more manganese than in package six but the bone is better preserved and not so fragile as in the upper packages. From packages fourteen to nineteen the bone becomes even darker in colour with occasional patches of manganese staining. In some units a few bones have been burnt (in Burnt Soil and Pale Burnt Gordon Banks in package fifteen), but on the whole very few bones were burnt throughout the deposit at EBC.

4.8: Fish species representation and palaeoenvironments

In this section I will describe the species composition of the fish bone assemblages from the packages at EBC. As with any other faunal remains, the number and kinds of species are related to the environmental context from which they come. Of particular interest is the history of the Verlorenvlei, which other evidence suggests has changed its character dramatically over the millennia. EBC has stood as a particular vantage point in a changing landscape and has witnessed sequential change in its immediate context. Although, as is often the case with faunal assemblages, there is some correlation between the number of taxa and sample size, some of the changes in number of taxa are independent of sample size and will be considered as evidence of changes in either habitat or procurement.

The earliest assemblages of fish bone are small, but nevertheless seem to reflect a clearly estuarine environment, with only the southern mullet *Liza richardsoni* and the white steenbras *Lithognathus lithognathus* present. It is my impression that these fish were caught in the lower reaches of the estuary, which are the favoured habitats of the southern mullet. Package sixteen is interesting in having 5 species, including the dassie *Diplodus sargus capensis*, the white stumpnose *Rhabdosargus globiceps* and the elf *Pomatomus saltatrix*, all of which are occasional visitors to estuaries. There seems to be some difference between the situation in this package and that of the following two, because the ratio between NISP and MNI is so different. Whether package sixteen reflects a temporary circumstance that was reversed, is a question that requires more evidence. The fish fauna in package sixteen reflects a species composition and size which is similar to that expected in a modern coastal estuary (Appendix B; Mehl 1973).

The drop in species numbers in package fifteen is surely significant, given the very substantial increase in fish bones. Packages fifteen and fourteen are dominated by the southern mullet and have smaller numbers of the flathead mullet for the first time at the site. Other than a single kob *Argyrosomus hololepidotus*, these samples are persuasively estuarine, with the southern mullet pointing strongly to fishing in the lower reaches.

A very important shift in fish bone composition occurs in package thirteen, which is brought about by the continued rise in sea level and the arrival of the lower estuary to a point within a few kilometres of the site.

From here on the dominant species is the white steenbras, white stumpnose becomes common and the range of fish species represented increases. The Verlorenvlei had become a coastal estuary/lagoon through a rise in sea level round about this time. The fish fauna now includes six species which are common in estuaries.

The occupational hiatus at 8000 BP appears after the progressive drowning by the sea of the Verlorenvlei estuary, creating lagoon conditions during the hiatus period. This is substantiated by evidence gathered by Martin (1962), who reported a 2.5 m transgression dated at 6800 BP from Knysna and Flemming (1977) who also recorded a number of erosional cliffs and substantial oyster beds at Langebaan Lagoon, dated to approximately 6400 BP. These observations indicate that the Cape coast was affected by a rise in sea level of up to 3 m during the mid Holocene.

When occupation resumes after the hiatus at around 4300 BP, the fish bone displays the largest variety of species in the site (Table 4:1). Five of the species present in package nine to six such as galjoen *Coracinus capensis*, snoek *Thyrsites atun*, zebra *Diplodus cervinus hottentotus,* hottentot *Pachymetopon blochii* and kingklip *Xiphiurus capensis*, do not enter lagoon or estuarine environments. These species are suggestive of coastal fishing in a marine habitat. It is possible that both estuarine and marine habitats were utilized during this period, but the size range of estuarine species such as white steenbras and stumpnose, indicates that larger sized steenbras were caught than normally found in estuarine habitats (Figure 4:3b).

On the other hand it may be related to periods of cold water upwelling as experienced recently, where large numbers of fish such as kingklip, galjoen, snoek and hottentot died because of a rise of oxygen depleted water that reached close inshore. This kind of episode would have resulted in many fishes being washed up, in which case large fish could easily be collected from the beach and taken to the cave for later consumption. The presence of species such as snoek *Thyrsites atun* and kingklip *Xiphiurus capensis* (are fishes normally caught in deep water) in the deposit suggests that such a phenomenon may have been responsible for the presence of these species.

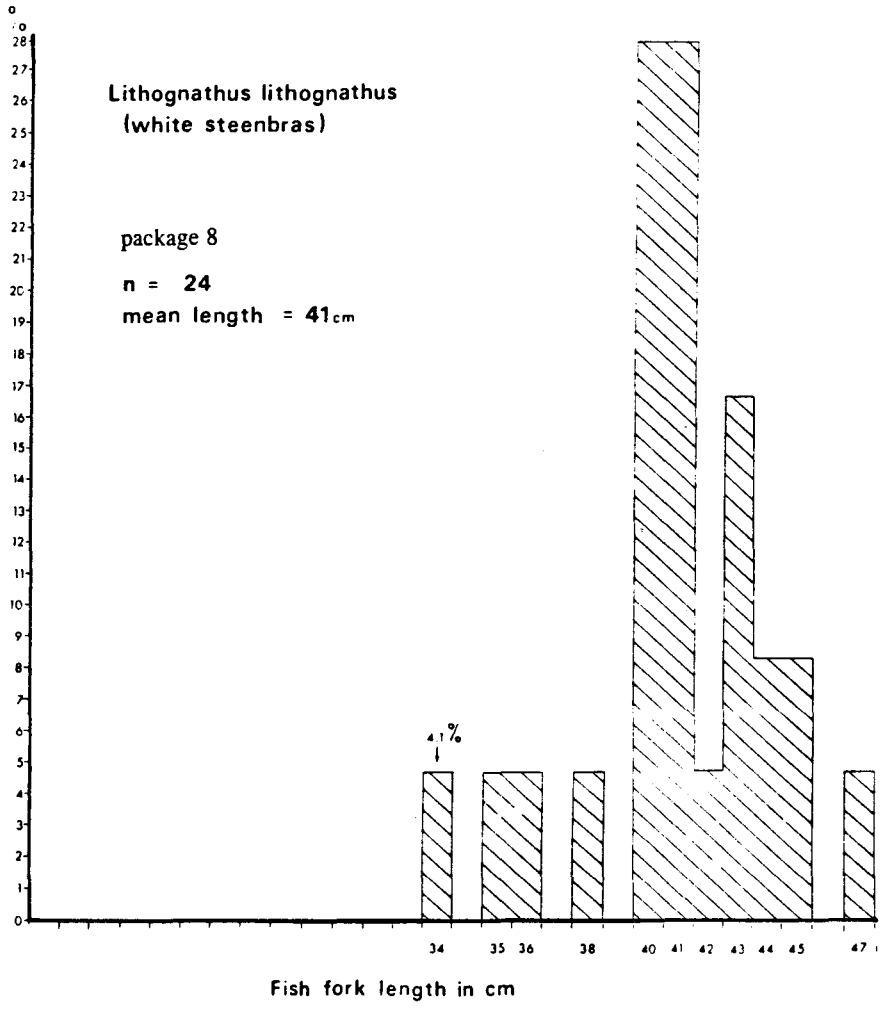


Figure 4:3b. The size distribution of white steenbras *Lithognathus lithognathus* in package eight from EBC.

No snoek or kingklip have been identified from the fish bone assemblages from more than thirty other prehistoric sites in the western Cape and along the south-east coast. Although large numbers of snoek elements have been recovered from historic sites such as the Castle in Cape Town, Bree Street, and Posthuys near Muizenberg, and its presence is presumably related to the use of boats. Ethnographically no evidence for the use of boats by indigenous coastal dwellers for marine fishing has been recorded, and the presence of snoek and kingklip at EBC may indicate that during the accumulation of package eight, cold upwelling may have been responsible for certain species being washed ashore and later collected by the inhabitants of the cave.

Another very significant shift in the fish bone assemblages occurs between packages four and three, at about 1000 years ago. Packages five and four have 8 and 7 taxa respectively, whereas there are only two taxa present, and always the same two, above that. The low incidence of taxa present in the three uppermost packages is almost certainly related to the closing of the estuary. The fact that the two taxa are the white steenbras and the flathead mullet, which can tolerate low salinities, and whose fry depend on estuaries as nursery grounds (Wallace *et al.* 1984), supports this.

Alongside the drop in species numbers is a substantial drop in fish bone as a whole. There are, in fact, almost no fish in the uppermost three packages dating to the last thousand years. The closure of the estuary mouth at that time meant the loss of any real fishing opportunity, and the effective collapse of the precolonial fishing industry, at least from the vantage point of EBC. Fish appear not to have played any significant role in bringing people to the coast in the closing millennium of the precolonial period.

4.9: The estimation of fish size

Whenever whole premaxillae and dentaries of white steenbras *Lithognathus lithognathus* were recovered, length measurements were taken to help estimate the size of fish caught. The measurements were taken with a dial calliper along the length of the maxillae (Figure 4:4).

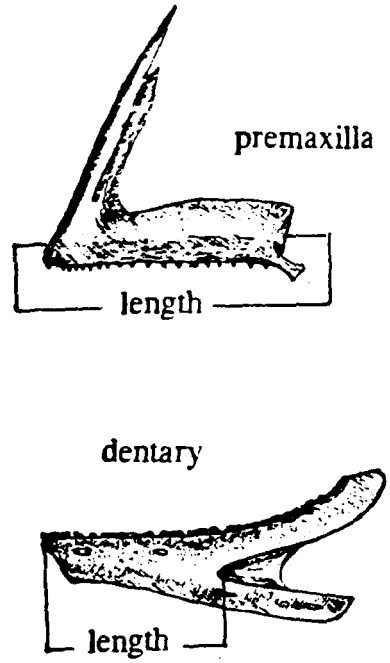


Figure 4:4. Shows the measuring points taken on comparative white steenbras *Lithognathus lithognathus* premaxillae and dentaries to generate fork length measurements for the archaeological specimens.

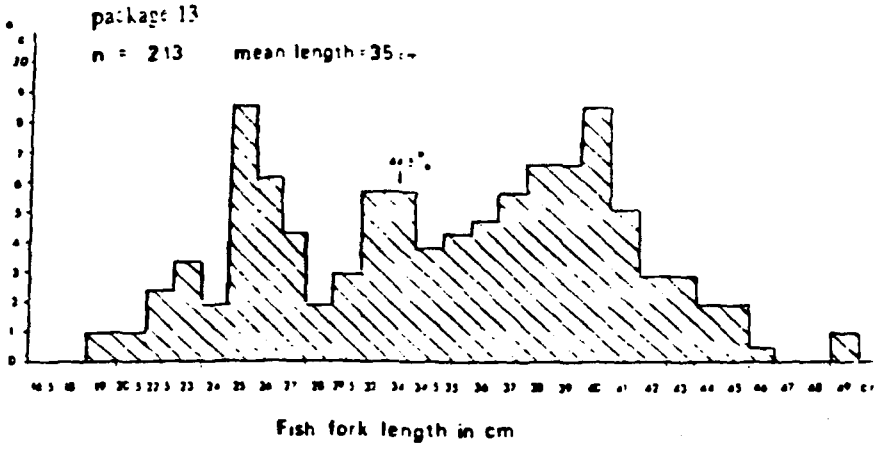
The maxillary and dentary lengths were then compared with similar measurements on a modern fish sample, which showed that a good relationship exists between the fish fork length and premaxilla and dentary lengths. Regression analysis gave the equation for the relationship between fork length and premaxilla length for the white steenbras as 13.78526 (pmax. length) + 2.3505 = fork length, with an r^2 of 0.997008.

The measurements taken on white steenbras premaxillae showed that the size of the steenbras varies from package to package. The number of small white steenbras present in package thirteen has influenced the graph and shows a distribution that is low peaked and spread (Figure 4:3a), whilst the white steenbras from package eight are large and lack age classes smaller than 25 cm (Figure 4:3b).

As much as 44% of the steenbras from package thirteen fall inside the estuarine range, whereas only 4% of the steenbras in package eight are of estuarine size. It is possible that the fish size variation may be related to technology since fish gorges are present with the fish in package thirteen. But the disappearance of very small steenbras in package eight probably monitors the shift in the catchment of EBC from upper to lower estuarine utilization. In package six, as much as 21.7% of the steenbras falls in the estuarine range and an even higher percentage of 34.2% can be seen in package four, which indicates a return to catching smaller steenbras although no fish gorges are present in the latter packages (Figure 4:3c). This increase of smaller white steenbras in the upper packages seems to indicate that the size of white steenbras caught may be independent of the use of fish gorges as a means of procurement and that the size of white steenbras caught may relate to habitat selection.

4.10: Fish body parts

As a contribution to the on going debate of the importance of fish in the reconstruction of diets and environments, Appendix B and C gives some background of the more common species with illustrations of the diagnostic bones often found in archaeological assemblages.



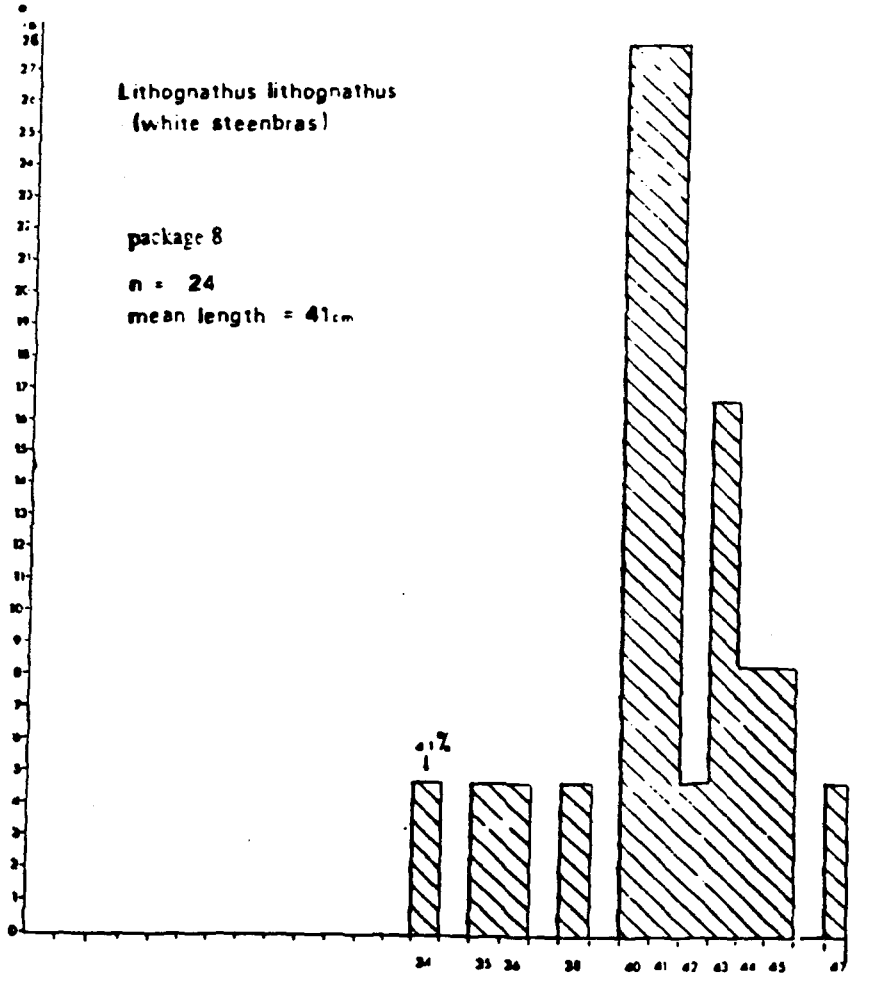


Figure 4:3a and 4:3b. Package thirteen shows that 44.5% of the white steenbras mandibles measured are of juvenile size whereas only 4.1% of the white steenbras in package eight falls in the estuarine size range.

white steenbras *Lithognathus lithognathus*

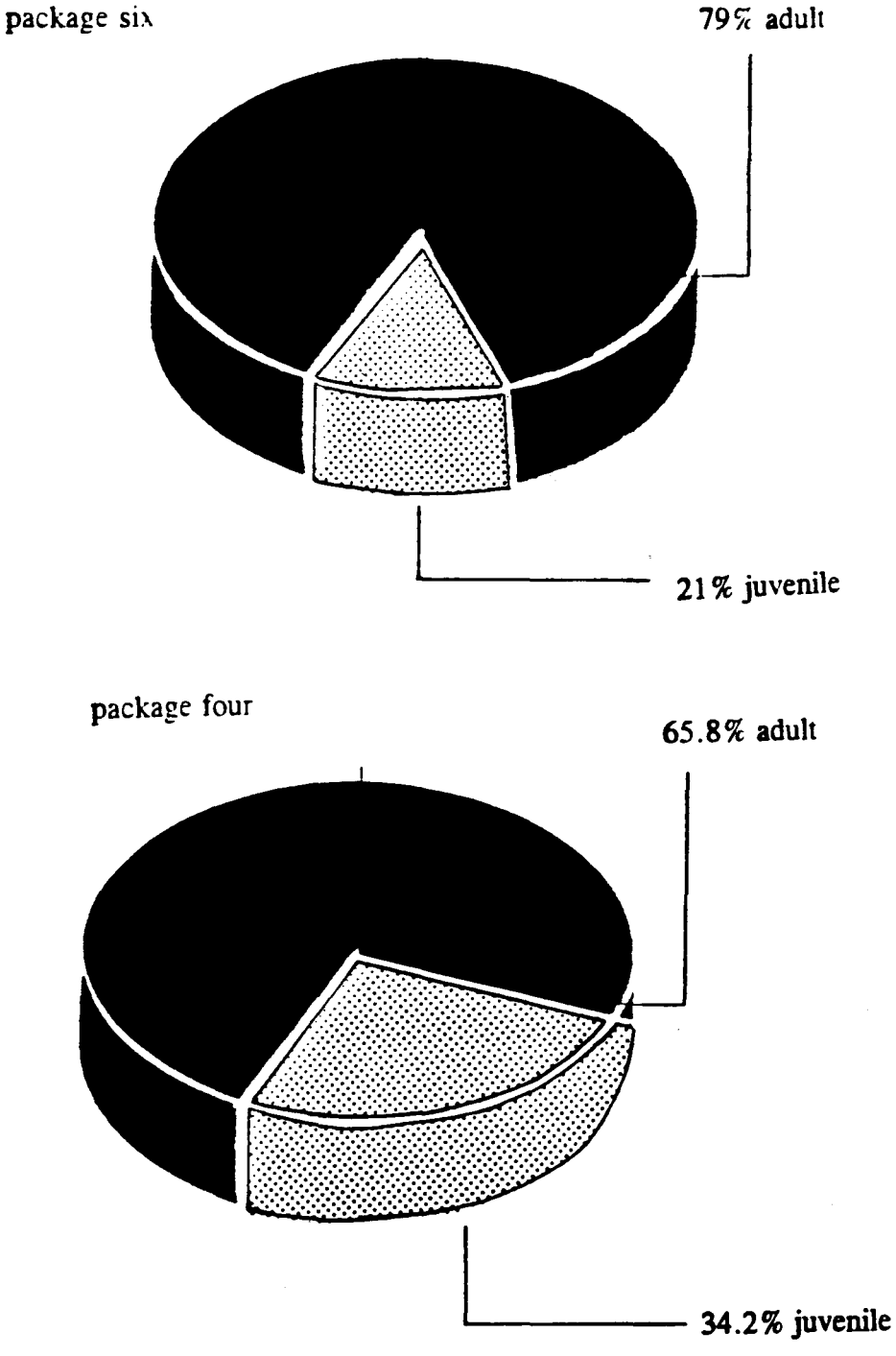


Figure 4:3c. Shows the increase percentage of juvenile white steenbras in package six and four in the Elands Bay Cave (EBC) sequence.

The neurocranium of a fish is made up of a number of paired and unpaired bones and some of these bones have been illustrated to help identification and the calculation of MNIs for the various taxa represented in this thesis. Due to the fragmentary nature of prehistoric fish assemblages only 16 cranial bones were selected for identification, and these include most of those used here to identify and count fish. The premaxillae, maxillae and dentaries are included and have been the bones most frequently measured for use in estimating fish sizes. The most common cranial bone besides jaw bones to survive in the fish samples seems to be the entopterygoid bone (Table 4:2).

4.11: Fish vertebrae

It is a common belief amongst researchers dealing with archaeological sites that have fish remains, that fish vertebrae are the most common fish bone normally recovered from the excavations. I would like to demonstrate that the fish vertebrae from EBC and TC vary from layer to layer in relation to the MNIs and that this variation is not related to movement of fish bone in the sequence but rather an indication of fish procurement, processing and consumption.

Since the most common fish from the Elands Bay sites are members of the Sparidae and Mugilidae families both of which have an average number of 26 vertebrae per vertebral column, this number has been used as a means to reach a MNI count alongside the use of premaxillae and dentaries and atlas vertebrae (Table 4:3). In this table the point is to differentiate MNI calculations based on head parts from those based on vertebral column or trunk parts.

Using the MNI calculated from premaxillae and dentaries for all units of 1814 individuals, the expected number of vertebrae would be 47 164, whereas only 39 981 vertebrae were recovered. This overall shortfall of about 7000 vertebrae increases to 12 649 vertebrae, or the equivalent of 486 fishes, when the calculation is done by package.

ELANDS BAY CAVE

FISH REMAINS

Stratigraphic Packages	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	TOTAL
vertebrae	48	41	103	1196	1103	719	158	1334	1140	2706	1045	412	18244	2937	8321	406	48	19	1	0	39981
articular	0	2	3	53	51	17	15	56	29	76	33	4	627	53	16	3	3	0	0	0	1041
entopterygoids	0	1	1	39	52	18	6	59	26	69	50	4	602	38	19	4	0	0	0	0	988
hayomandibulare	1	1	2	35	66	19	10	47	49	57	35	6	362	70	128	4	1	0	0	0	893
atlas vertebrae	1	2	4	40	40	13	2	23	25	24	26	10	185	67	163	12	0	0	0	0	637
coracoid	0	1	1	34	58	13	1	71	11	37	31	0	266	25	24	0	1	0	0	0	574
quadrates	0	0	0	26	28	6	5	42	12	32	23	2	280	17	24	3	0	0	0	0	500
opercularе	0	0	1	19	22	8	0	19	16	29	18	3	284	35	35	0	0	0	0	0	489
urostyle		0	2	23	15	7	4	20	27	20	30	16	129	35	109	2	4	1	0	0	444
basi occipitale	0	1	2	25	19	12	1	27	11	7	21	3	93	32	151	7	2	1	1	0	418
parasphenoids	2	0	1	32	36	6	9	33	22	26	19	2	136	17	28	4	0	0	0	0	373
supra occipitale		0	3	13	22	10	4	32	14	18	13	4	147	13	31	9	0	0	0	0	333
frontal	0	0	0	17	35	12	5	37	25	30	3	4	95	9	7	2	0	0	0	0	281
post temporal	0	0	2	21	47	5	2	36	10	0	6	1	80	15	0	3	0	0	0	0	228
ventral spine	1	0	1	22	19	11	3	26	10	10	14	5	75	13	1	4	0	0	0	0	215
ceratohyal	0	0	1	18	38	7	0	13	22	0	2	1	74	8	0	0	0	0	0	0	184
cleithrum	0	0	0	11	50	2	0	39	0	8	2	0	15	2	23	0	0	0	0	0	152
interhayal	0	0	0	7	6	1	2	3	3	0	2	1	94	1	4	5	0	0	0	0	129
premaxillae	0	0	0	4	5	2	0	10	0	0	1	1	68	1	6	3	0	0	0	0	100
nasal bone	0	0	0	5	11	1	1	12	0	0	0	0	28	2	0	0	0	0	0	0	60
post cleithrum	0	0	0	11	50	2	0	39	0	4	0	0	0	2	15	0	0	0	0	0	123
otoliths	0	0	0	0	1	0	0	0	0	2	0	0	13	0	0	0	0	0	0	0	16
subopercularе	0	0	0	2	5	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10
Total	62	49	127	1653	1779	994	228	1978	1452	3155	1374	479	21897	3392	9107	471	59	21	2	0	48169

Table 4:2. Shows the distribution of fish elements through the EBC sequence.

Elands Bay Cave

MNI and Vertebrae counts

Package	MNI	Vert.	Exp.Vert.	deficit	surplus
1	2	48	52	4	-
2	2	41	52	11	-
3	3	103	78	-	25
4	46	1196	1196	-	-
5	52	1103	1352	249	-
6	32	719	832	113	-
7	12	158	312	154	-
8	49	1334	1274	-	60
9	91	1140	2366	1226	-
10	61	2706	1586	-	1120
11	51	1045	1326	281	-
12	14	412	364		48
13	1107	18244	28782	10538	-
14	73	2937	1898	-	1039
15	200	8321	5200	-	3121
16	13	406	338	-	68
17	4	48	104	-	56
18	1	19	26	7	-
19	1	1	26	18	-
Total	**1814**	**39981**	**47164**	**12601**	**5537**

Table 4:3. Shows the distribution of fish vertebrae and MNI plus the deficit and surplus amounts through the sequence of EBC.

This increased deficit is the result of the fact that some units show a surplus of 4585 vertebrae, the equivalent of 176 fish. All layers above the second hiatus, that is after about 4300 years ago, with the relatively minor exceptions of packages three and eight, have a deficit of vertebrae registered.

This may mean that fish caught at the shoreline near the site were beheaded and the vertebral column transported elsewhere, perhaps in dried form. This pattern is repeated at TC through the Holocene deposits. By contrast, in terminal Pleistocene packages fourteen, fifteen and sixteen between 10 000 and about 11 000 years ago, at a time when terrestrial animals feature strongly in the faunal samples, the vertebrae reflect a surplus. Of the 11 664 vertebrae from these units almost 40% are surplus. Assuming the coastline to have been a few kilometres away from the site, this may imply that people brought beheaded fish back to EBC. This may strengthen the argument that during package fourteen to sixteen fishing took place at the estuary mouth near the coast, which may have been as much as 10 or 15 kilometres away. Some support for this comes from the identification of specific species among the fish from packages fourteen to sixteen. The identification of the fish remains in the lower deposits at EBC has produced only three species of fish, white steenbras *Lithognathus lithognathus*, white stumpnose *Rhabdosargus globiceps* and the southern mullet *Liza richardsoni*, which belongs to the Mugilidae family. The very earliest samples of fish contain only Mugilidae. Previous thinking on this pattern was that the Mugilidae may have been the flathead mullet *Mugil cephalus* which has a tendency to move well upstream and may have been taken in fresh water near the cave (Poggenpoel 1987). At this stage in the analysis it was not possible to distinguish between *Mugil cephalus* and *Liza richardsoni* on the basi-occipitals and atlas vertebrae.

Subsequent more detailed re-analysis of the Mugilidae atlas and basi-occipital bones, has now shown that none of the bones from these lower units belong to the flathead mullet species as assumed previously, but that they all belong to the southern mullet *Liza richardsoni* (see Appendix B). This discovery ruled out the possibility of the fish being caught in the freshwater stream since southern mullet cannot tolerate low salinities and seldom travel more than a few kilometres upstream in estuaries (Wallace 1975). Because southern mullet congregate in the lower reaches around the

mouth, the presence of only southern mullet in the lower deposits at EBC certainly reflects the exploitation of the estuary mouth that was some distance to the west of the cave. Taken along with the large numbers of terrestrial animal bones, this means that at the time when the estuary mouth was exploited, EBC was an inland site. The fish transported back to the cave may have been headless in a dried form, hence the low incidence of cranial bones in the fish sample. In units from packages seventeen to nineteen there is again a deficit of vertebrae but the numbers are too low to be of any significance.

An extremely interesting point is that, of the large number of vertebrae missing from the total predicted from the head bone counts, 10 512 of them are missing from package thirteen. This is the equivalent of 404 fish which are represented by head bones and not by vertebrae. By the same argument as used to explain the previous surplus, the deficit in this package may reflect the beheading of fish during drying and the subsequent export of vertebrae and trunk from the site. Vertebral columns and trunk regions are missing because fish caught near the site were transported elsewhere, perhaps inland. This is overwhelmingly supported by the abrupt shift at EBC in package thirteen to marine foods. Seals, crayfish and sea-birds are now abundant alongside the shellfish, and all evidence points to the proximity of the shoreline to the cave. The dramatic shift from surplus to deficit between packages fourteen and thirteen is accompanied by an equally dramatic shift from Mugilidae to Sparidae, itself an indication of the fishing habitat and procurement stratigies changing from what was seen in the previous packages.

The situation in the packages between package thirteen and package nine is not quite as clear. Package eleven includes several units that are obviously disturbed and may incorporate fish bone that was originally deposited during the time of package thirteen. Although superficially similar to packages fourteen to sixteen in having a surplus of vertebrae, package ten differs from the lower fish bone assemblages in not being dominated by Mugilidae. No obvious interpretation occurs to me, but some shift in fishing practices between packages thirteen and ten seem to be involved.

It could be argued that the lack of fit between the numbers of vertebrae and the MNIs established from cranial bones is the result of some

movement of vertebrae through the deposit or from poor preservation of fragile bones. The fact that the deficits and surpluses are so patterned and coincide so well with other evidence for habitat shifts at the site make these arguments unconvincing. The fit between the EBC and TC, observations also underlines the value of this technique as an indicator of fishing procurement practices.

The counting of fish vertebrae has allowed the development of a three stage argument on processing behaviour. First, it is clear that very little movement of fish vertebrae has taken place through the deposit, especially well illustrated in the upper units where almost all units show a deficit of vertebrae. Secondly, because the taxa represented in the fish sample are restricted to one or two families, an average number of vertebrae per vertebral column can then be calculated and compared with the MNI generated from cranial bones for the sample under study. Thirdly, the discrepancy between the number of vertebrae present in any layer and the MNI, whether deficit or surplus, can be related to the processing of fish in those units. The proposed explanation for the discrepancies can then be linked to changes in habitat use and movements between sites among coastal groups.

4.12: The use of chemical analysis to identify fishing habitats at Verlorenvlei

The selection of various fishing habitats for fishing in prehistoric times can be understood from the species composition in fish assemblages. As an alternative approach to understanding and interpreting the species diversity and size variation through the sequence at EBC, one of the more dominant fish species white steenbras *Lithognathus lithognathus* was chosen for chemical analysis to measure the barium/strontium (Ba/Sr) ratio in the prehistoric fish bone. A preliminary study of the Ba/Sr ratio in fish bone has shown that the Ba/Sr ratios in modern freshwater catfish, estuarine southern mullet and marine fishes are statistically significantly different from one another (Poggenpoel in press).

Archaeological fish bone samples were taken from previously dated horizons from the excavated sites of Elands Bay Cave and Tortoise Cave, specifically packages thirteen, eight, six and four from EBC and the uppermost layer from TC. I decided to use premaxillae for analysis so that there would be no confusion in terms of taxon identification and because

premaxillae can also be used to establish the size of the white steenbras. One premaxillae from each layer have been chosen for analysis. The EBC samples are radiocarbon dated to between 10 000 and 3000 years ago and the sample from TC is dated to about 760 years ago. I had initially assumed that the size variation in premaxillae at EBC is related to a change in procurement strategy, since the fish assemblage found in the lower deposit of package thirteen is associated with small fish gorges (mean size 28 mm), whereas those later than 4000 years have none. More than 44% of the fish in package thirteen are smaller then 34 cm in length whilst in package eight only 4.1% are of that size. Because of this patterning the small sized white steenbras in package thirteen were attributed to the use of fish gorges. The dramatic increase in the number of smaller white steenbras in packages six and four, however, where there are no fish gorges, suggests that the size of the fish may be independent of a procurement strategy and may relate to habitat selection rather than a fishing technique.

The archaeological samples selected for chemical analysis were treated differently from the modern samples. Modern samples were weighed out and then digested in 100μl of concentrated nitric acid in borosilicate glass at 150°C. The samples were brought to dryness and redissolved in 1ml of 0.2N nitric acid. Digestions were performed in duplicate. If the difference between the two was greater than 10% then digestions were repeated and the average of four digestions taken.

The archaeological samples were prepared according to the solubility profile procedure in order to remove the more soluble diagenetic mineral leaving biological apatite in the remaining residue (Sillen & Sealy 1986). Each specimen is milled under liquid nitrogen to obtain a fine powder. Fifty mg of powder is placed in a microcentifuge tube. One ml of sodium acetate/acetic acid buffer adjusted to a pH of 4.5 is then added to the powder, sonicated for one minute then rapidly centrifuged for 10 seconds to separate the powder from the buffer. The buffer is then decanted and the process repeated 20 times. The resultant washes are analyzed. Ca, Sr and Ba are measured separately on a GBC 902 Atomic Absorption Spectrometer. Figure 4:5 illustrates the Ba/Sr and Ba/Ca ratio's of the modern samples and shows the position of the prehistoric samples. Note, that the marine sample include four species that does not enter estuaries, 2 hottentot *Packymetopon blochii*,

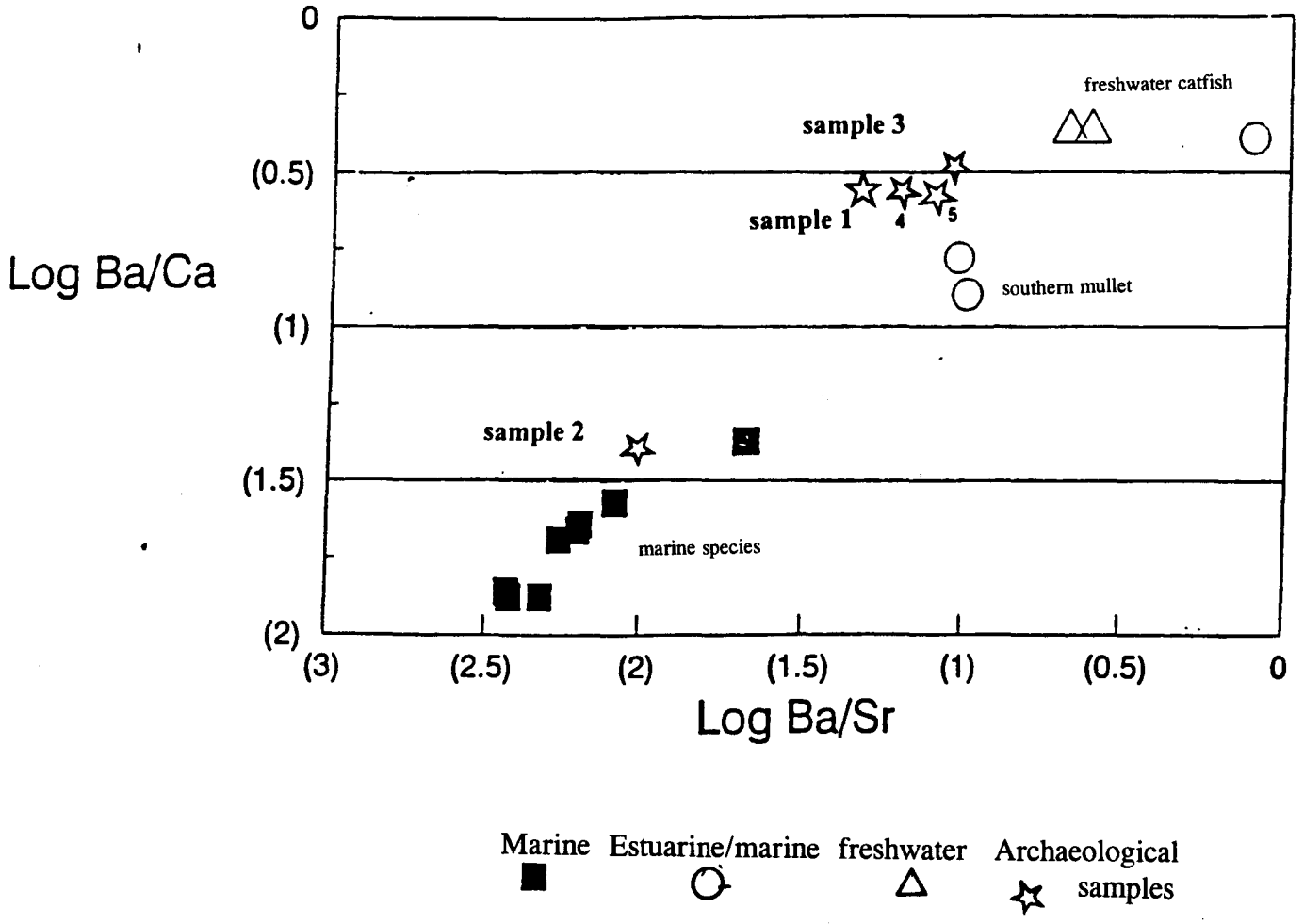


Figure 4:5. Shows the distribution of marine, freshwater, estuarine/marine fish bone samples and archaeological white steenbras *Lithognathus lithognathus* samples from EBC and TC. Sample 1 was taken from package thirteen, sample 2 from package eight, samples 3 and 4 (package six and four) and sample 5 was taken from the upper levels at TC. In order to condence the scale and make the data more comparable, Ba/Sr and Ba/Ca are presented as a log to the base ten.

2 red roman *Chrysoblephus laticeps*, 2 mackerel *Scomber japonicus* and 2 black musselcracker *Sparadon durbanensis*, the estuarine/marine sample consists of 2 southern mullet *Liza richardsoni* and the freshwater sample 3 freshwater barbel *Clarias gephyroglanis*. In the case of the marine fish, this demonstrate that the marine signal is consistant between species. These results show that fish caught about 9600 BP in package thirteen (sample 1*) were taken from the estuary mouth, because they resemble the readings from a modern estuary mouth sample (Appen.B. Figure 2). Based on the available bathymetry we estimate that the estuary mouth was some 5 km to the west of its present position at that time (Parkington 1976a, 1976b, Miller 1981, 1987; Miller *et al.* 1993; Yates *et al.* 1986; Jerardino 1993). Sample 2*, however, from package eight and dated to about 3780 years ago, has large white steenbras and is suggestive of more open coastal conditions and possibly of greater usage of a marine habitat. Samples 3* and 4*, from packages six and four dating to about 3500 and 1300 years ago respectively, are positioned close to sample 1* on the graph and suggest a return to estuarine utilization. Although during this period the estuary mouth was already in its present position. Sample 5* comes from the top of the deposit at TC (Layer 1b), dated to about 760 years ago, suggests riverine /estuarine exploitation and marks the closure of the estuary and the onset of the present coastal lake conditions at Verlorenvlei. When the size measurements of the white steenbras is compared with the Ba/Sr results from the from EBC, then the data is more supportive of the utilization of different fishing habitats. In package thirteen the size observations indicate that 76.4% of the fish that was caught are more often located in the lower reaches of estuaries, whilst only 23% of those caught were of a size able to leave the estuary for the open sea. In package eight the white steenbras sizes indicate that only 16.4% of the fish caught are normally found in the middle reaches of estuaries, whereas 83.6% falls in a size category that gave a Ba/Sr marine signal (Figure 4:6&7). This suggests that the majority of the fish caught in package eight were captured in a marine habitat. The white steenbras sizes from packages six and four looks similar to package thirteen and the suggestion is that during the accumulation of the upper deposits in the site, occupation took place during the spawning period during the winter months.

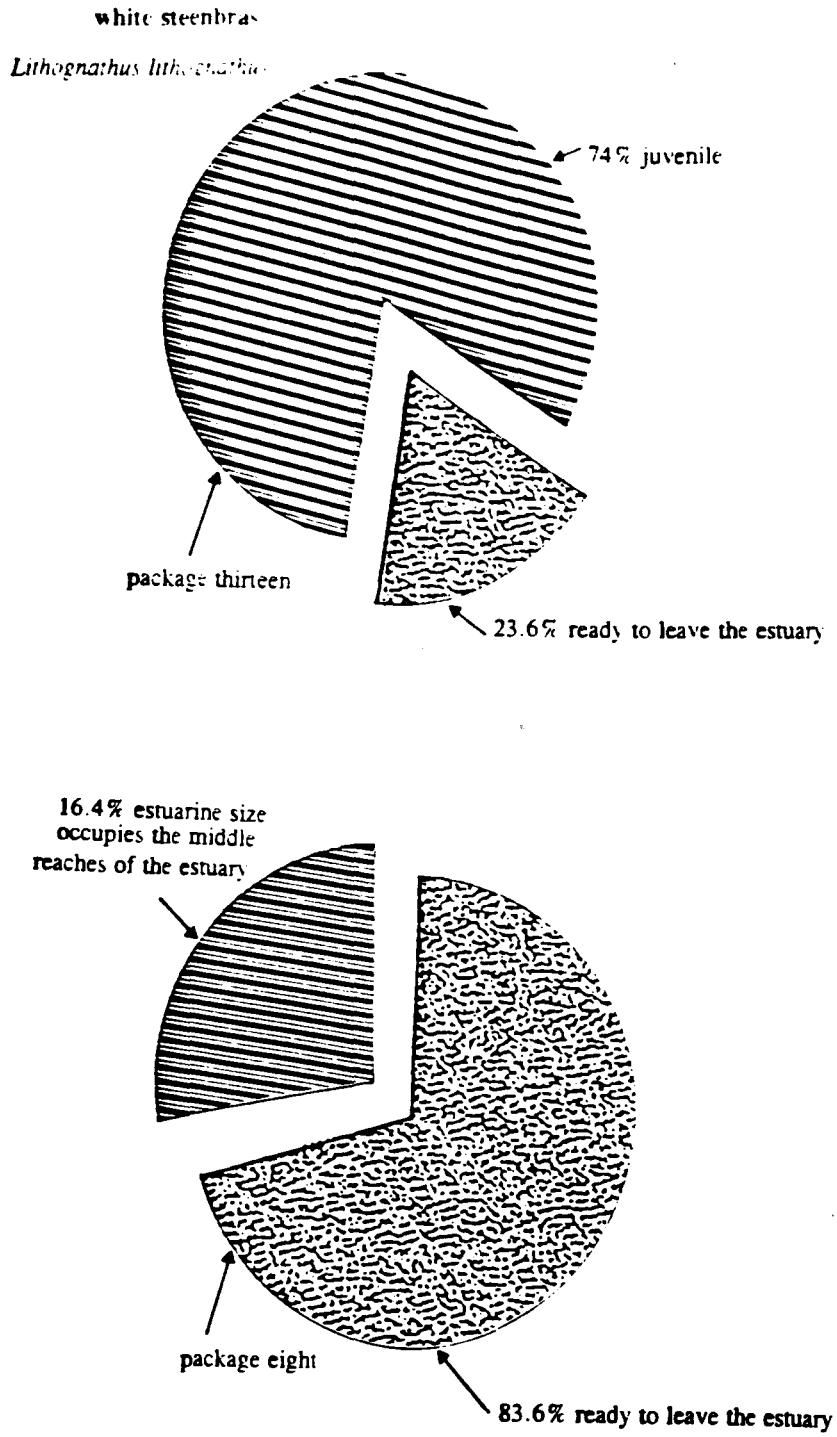


Figure 4:6 & 7. Show the size of white steenbras *Lithognathus lithognathus* ready to leave the estuary from package thirteen and eight in the Elands Bay Cave sequence.

CHAPTER FIVE

TORTOISE CAVE (TC), SPRING CAVE (SC) AND DIEPKLOOF ROCK SHELTER

5.1: Tortoise Cave (TC)

This site, a small shelter 4 km inland along the south bank of the Verlorenvlei, was excavated over a period of six years from 1978-1983 and has subsequently been re-analysed (Robey 1984, 1987; Jerardino 1993). One of the major aims was to expand on the cultural and biological samples excavated at EBC near the coast. The site has a large shell mound in front of the shelter, with relatively little deposit under the protection of the overhang. The site was excavated in fine stratigraphic units which were later placed into aggregates or layers through a study of the taphonomic implications of each unit and the repetition of patterns of unit type and association (Robey 1984). On the basis of a new matrix constructed by Jerardino and Yates (pers. comm.) and myself, (see Appendix A) with the help of new radiocarbon dates, some units and layers have been changed from the earlier stratigraphy put forward by Robey (1984).

Robey (1984) subdivided the deposits into three sets, which he called the basin deposits, the lower talus deposits and the outer cave deposits. The basin deposits (layers 1-3), which comprise the bulk of the deposit inside the shelter, are the most recent. They are composed of a series of shell lenses around the back and side walls of the cave, with shelly units and hearths in the central area. Pottery is present in all three layers with

bedding preserved only in layers 1 and 2. Note that layer 1a is a surface layer that contains mixed samples. Although the number of fish bones is given in Table 5:1, these bones are not included in the analyses that follow. The lower talus deposits (layers 5-8) belong to the period between the basin deposits and the outer cave deposits. These deposits are largely undifferentiated, redeposited material that was removed from the inside of the cave by the inhabitants to create space inside the small shelter. The outer cave deposits are located along the dripline to the edge of the basin and in front of the cave. Many are poorly stratified ash and soil lenses sometimes disturbed or in secondary context with some hearths and primary shell lenses *in situ*.

5.1:1: Shellfish in relation to environmental changes in the Verlorenvlei

Previous analyses of faunal remains from the site have been used to argue for substantial changes in the water body in front of TC. According to Jerardino (1993), who has studied the shellfish composition at TC, the abundance of the molluscs *Solen capensis* and *Venerupis corrugata*, which are environmentally sensitive, can be used to interpret changes in sea level and, thus, in the configuration of the vlei. *Solen capensis*, the razor shell, is an estuarine shellfish found mainly in clean tidal sands at the mouths of river estuaries; it will not thrive in closed systems. *Venerupis corrugata* is a marine species that grows in protected bays along the open shores and presumably was brought into the cave as an accidental inclusion along with the byssus of mussels. Jerardino argues that a high abundance of *S. capensis* can be interpreted as indicative of estuarine conditions and large quantities of *V. corrugata* may relate to enhanced shellfish predation by hunter-gatherers in the vicinity of bay reefs during a high sea level stand. By this argument, a decline in numbers of both species would appear to be related to a drop in sea level (Jerardino 1993).
The shellfish evidence shows that layers 14 and 13b, which have shell corrected dates of 7700 $\pm$ 70 BP (Pta 3596) and 6910 $\pm$ 80 BP (Pta 5479) respectively, are characterized by a high abundance of both *S. capensis* and *V. corrugata*, as well as of *Dosinia spp.* and *Nassa kraussianus* relative to the younger layers.

All of these species are indicative of fully estuarine conditions existing around the river mouth, presumably the result of a higher sea level.
Although there are fewer *V. corrugata* than *S. capensis* in layers 13a and 11b, with a radiocarbon date of 4330 ± 50 BP (Pta 3605), nevertheless the highest abundance of *S. capensis* at TC registered in these layers strongly suggests estuarine conditions at the mouth of Verlorenvlei. In layer 10, with a radiocarbon date of 4190 ± 60 BP (Pta 3608), both species decrease dramatically. Jerardino (1993:485) believes that this is "related to a drop in sea level. For *S. capensis* the drop in sea level would have entailed a shrinkage of its habitat as enhanced onshore sedimentation and subsequent changes in the morphology of the river mouth transformed the surroundings into salt marshes and/or a coastal lagoon." A return to estuarine conditions is experienced during layer 8 dated to 4020 ± 60 BP (Pta 3595), possibly after a short hiatus, when *S. capensis* and *V. corrugata* again become abundant. Thereafter, there is a gradual decrease in the abundance of these shellfish species until layer 5a which confirms another shift from tidal estuarine conditions to a more closed coastal lagoon (Jerardino 1993).
After the second hiatus between layers 4 and 3b (3b being dated to 1800 ± 60 BP (Pta 5616), layer 5a to 3160 ± 60 BP (Pta 5498, corrected), layer 4 undated) *S. capensis* and *V. corrugata* are still present but in much smaller quantities. None of the layers after layer 3a has any of the shellfish species mentioned above, suggesting that the Verlorenvlei by this time has become a coastal lake, effectively closed to regular interchange with the sea.

5.1:2: Fish assemblage

More than 37 000 fish bones have been analysed and all species identifications were made on maxillae, premaxillae, dentaries, basi-occipitals, atlas vertebrae and otoliths. The fish sample yielded counts of 986 identified individual fishes, which comprise nine marine species. The most common bones used for identification of the Sparidae were the jaw bones, but in the case of flathead mullet *Mugil cephalus*, the highest MNI was achieved by counting basi-occipitals and the highest counts for sea catfish *Arius feliceps* were derived through counting otoliths (Table 5:1).

TORTOISE CAVE

IDENTIFICATION OF FISH TAXA

STRATIGRAPHIC LAYERS	1	1b	2a	2b	3a	3b	4	5a	5c	6	7	8	10	11a	11b	13a	13b	14		TOTAL
white steenbras	13	31	37	59	44	59	24	2	34	2	1	0	25	16	8	15	7	14	MNI	391
Lithognathus lithognathus	33	48	152	278	227	221	58	6	102	6	2	0	107	57	32	53	20	31	NISP	1433
white stumpnose	0	3	0	1	3	9	3	5	95	9	9	8	115	31	20	37	31	21	MNI	400
Rhabdosargus globiceps	0	5	0	4	7	31	3	6	381	24	17	10	586	155	74	193	111	86	NISP	1693
flathead mullet	2	3	19	6	5	4	0	0	9	0	0	1	7	3	1	1	1	2	MNI	64
Mugil cephalus	2	6	27	16	10	15	0	0	19	0	0	1	16	11	2	2	1	2	NISP	130
sea cat fish	1	0	0	0	0	0	0	0	36	12	9	3	12	0	1	1	1	4	MNI	80
Arius feliceps	1	0	0	0	0	0	0	0	72	24	17	3	23	0	1	2	1	8	NISP	152
elf																				
Pomatomus saltatrix	1	1	0	0	0	0	0	0	8	2	0	2	6	0	0	4	0	1	MNI	25
	1	1	0	0	0	0	0	0	21	2	0	2	17	0	0	4	0	1	NISP	49
hottentot	0	1	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	MNI	3
Pachymetopon blochii	0	1	2	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	NISP	5
cape kob	0	0	0	0	0	0	0	0	1	0	0	0	1	2	0	1	1	0	MNI	6
Argyrosomus hololepidotus	0	0	0	0	0	0	0	0	2	0	0	0	2	4	0	2	2	0	NISP	12
dassie	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	4	7	4	MNI	16
Diplodus sargus capensis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	5	14	4	NISP	25
steentjie	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	MNI	1
Spondyliosoma emarginatum	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	NISP	1
TOTAL	17	39	57	66	52	72	27	7	183	25	19	14	167	52	31	63	48	47	MNI	986
	37	61	181	298	244	267	61	12	597	56	36	16	753	227	111	261	149	127	NISP	3500

Table 5:1. The distribution of fish taxa through the stratigraphic sequence of TC near Elands Bay on the west coast of South Africa.

The variation in frequency of the most common species, white stumpnose *Rhabdosargus globiceps*, white steenbras *Lithognathus lithognathus* and flathead mullet *Mugil cephalus*, is particularly significant. Generally speaking, the white steenbras is the most common fish associated with archaeological sites in the vicinity of the Verlorenvlei, but at TC the abundances of white steenbras and white stumpnose are stratigraphically patterned. Although the white steenbras is present throughout the deposits, this species dominates the upper layers from 1b - 5a, but not those below. As many as 259 or 68.7% out of the total of 391 white steenbras identified at the site occur in the upper layers and constitute 76.8% of the fish from those layers. In contrast, only 24 or 6.0% of 400 white stumpnose are present, constituting only 7.1% of the total for the upper layers.

From layers 5c - 14 this situation is dramatically reversed, with an overwhelming domination by white stumpnose and much diminished numbers of white steenbras (Figure 5:1). In these lower layers a total of 376 or 94.0% of the white stumpnose identified at the site occur, constituting 57% of the total fish in these layers. The white steenbras numbers drop dramatically to only 18% of the fish identified in the lower layers. At precisely this time, in layer 5c, the sea catfish *Arius feliceps* appears in the sequence for the first time and continues throughout the lower deposits. The elf also appears more frequently in these lower deposits, which strengthens the argument for changes in the local environment of the Verlorenvlei in the interval between layers 5a and 5c.

Layer 5a is dated to 3560 $\pm$ 60 BP on shell (Pta 5498), which has been corrected to 3160 $\pm$ 60 BP to deal with the apparent age of sea water. Layer 5c is dated to 3810 $\pm$ 60 BP (Pta 5662) on shell, corrected to 3410 $\pm$ 60 years ago. The change in the fish assemblage is, thus, clearly dated to between 3400 and 3100 years ago. The preponderance of white steenbras in the upper layers of TC and the change to white stumpnose in the lower layers almost certainly reflects a response to changes in the Verlorenvlei fishing habitat from lagoon to estuarine conditions. Some support for this idea comes from the fish remains identified from the colonial site of OP1 on the Langebaan Lagoon, where the most common fish in the sample is the white stumpnose *Rhabdosargus globiceps*.

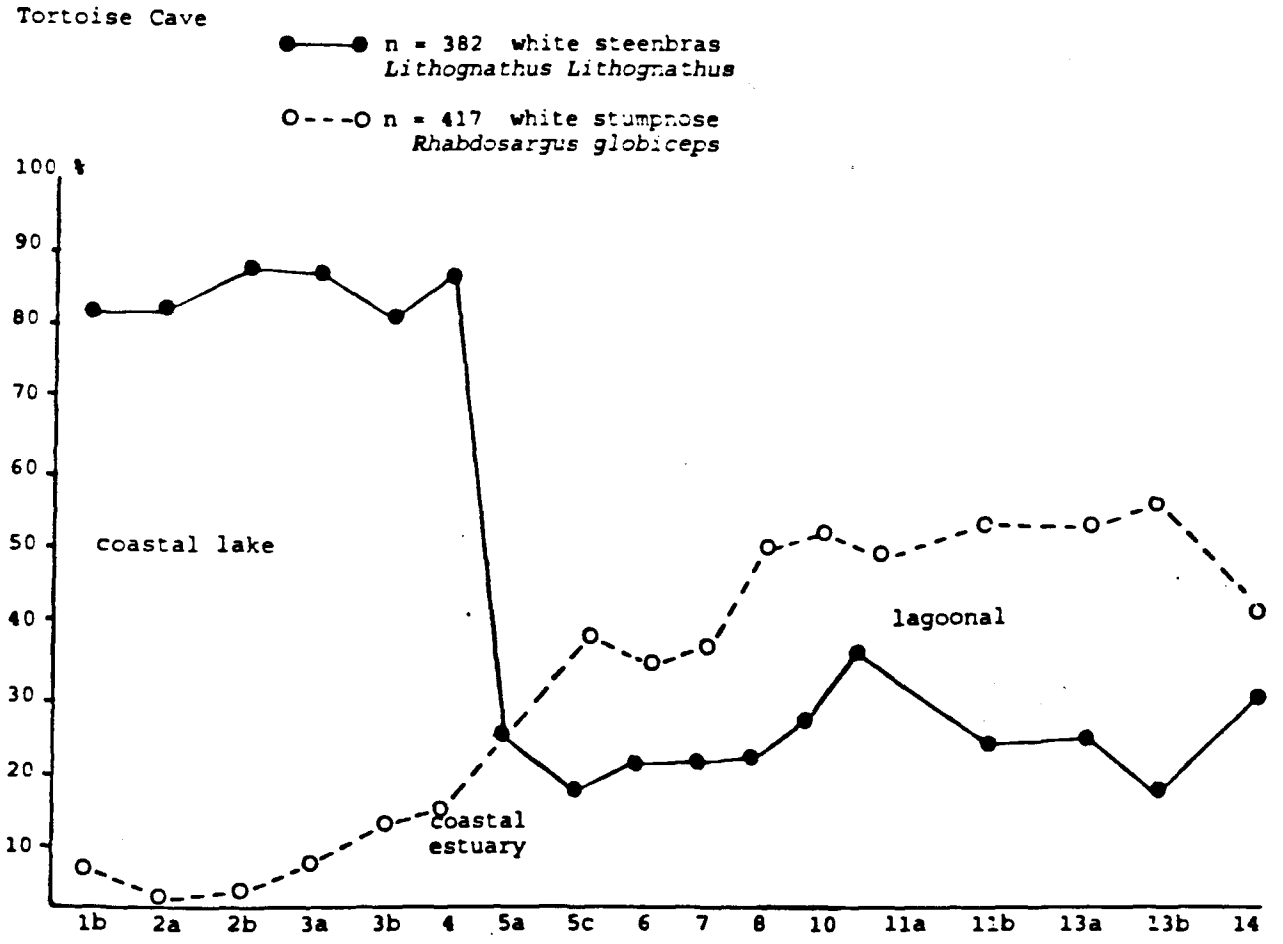


Figure 5:1. The distribution of white steenbras *Lithognathus lithognathus* and white stumpnose *Rhabdosargus globiceps* in the sequence of Tortoise Cave.

Without implying that the method of procurement was the same at the two sites, this does illustrate that white stumpnose congregate in lagoonal areas in large numbers (see Chapter Six). It is significant that the stratigraphic distribution of the flathead mullet at TC is very similar to that of the white steenbras, because they favour the same habitats (Wallace *et al.* 1984). As many as 37 or 59.6% of the 62 flathead mullet occur in layer 1b - 5a, although none of these are in layers 4 and 5a. All of the basi-occipital and atlas bones identified as Mugilidae belong to the flathead mullet rather than the southern mullet. Since the southern mullet tends to occupy the lower reaches of estuaries, due to its inability to tolerate low salinity areas, its absence from the TC sample strongly suggests that fishing took place in the middle reaches of the estuary where lower salinities occur. The flathead mullet is quite at home in the middle reaches of estuaries (Wallace 1975; Wallace *et al.* 1984).

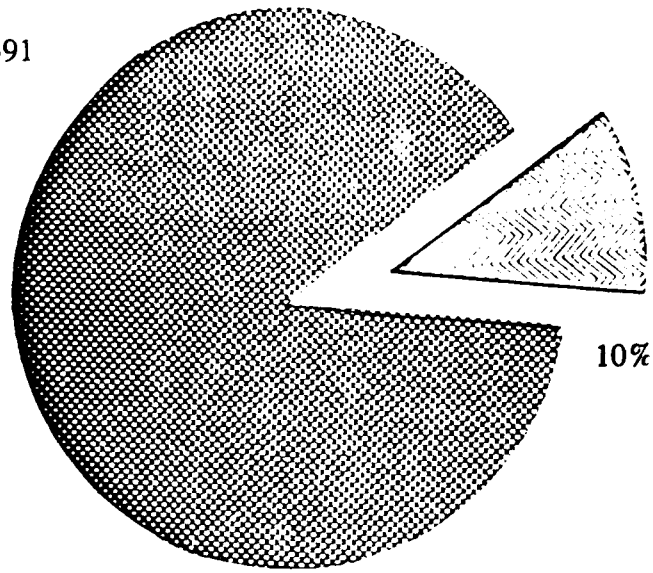
The size measurements of the white steenbras mandibles from the lower deposits indicate that a large number fall within the size range normally found in estuaries, as many as 90% are below the age of six years, (Figure 5:2). It would seem that the same is true for the upper deposits since the white steenbras post dating 1700 BP indicate that only 16% are larger than those found in estuaries.

5.1:3: Fish vertebrae

The distribution of fish vertebrae at TC indicates that throughout the deposit vertebrae are under-represented and in some layers there is a deficit of more then 90%. The fact that the deficit occurs throughout the deposit indicates that the under-representation of vertebrae is not related to taphonomic problems, such as the movement of vertebrae between layers. The condition of the vertebrae also rule out the argument that fragile vertebrae have simply not survived. Rather, I suggest that the trunk region of the fish with vertebrae may have been taken elsewhere and the head bones discarded at the site (Table 5:2). More than 16 000 vertebrae are not represented in the samples analysed, which is the equivalent of 615 fish, counted on cranial bones and not on vertebrae.

Tortoise Cave

white steenbras *Lithognathus lithognathus*



90% of the total white steenbras sample at Tortoise Cave are estuarine size fish

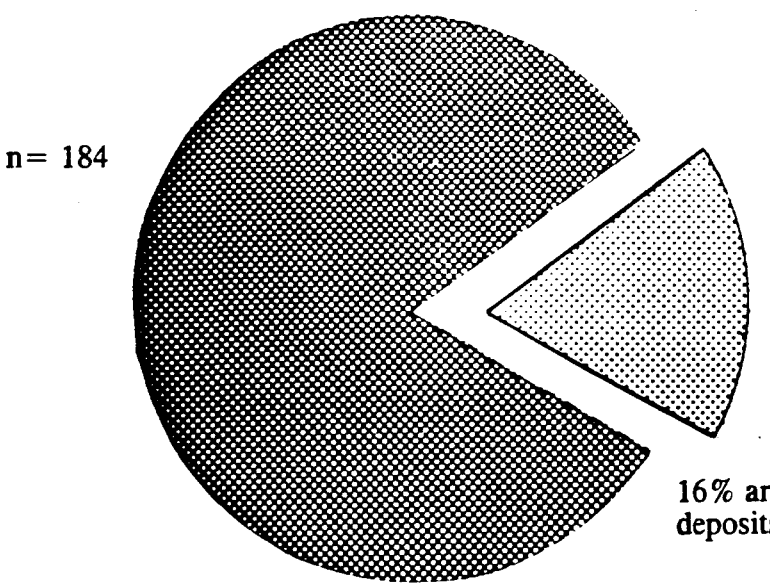


Figure 5:2. Shows that a small proportion of the total white steenbras catch at Tortoise Cave falls outside the estuarine size range.

TORTOISE CAVE

MNI and Fish Vertebrae counts

Layer	MNI	actual vertebrae	Expected vertebrae	deficit
1a	17	107	442	335
1b	39	454	1014	560
2a	57	368	1482	1114
2b	66	1051	1716	665
3a	52	1076	1352	276
3b	72	262	1872	1610
4	27	50	702	652
5a	7	111	182	71
5c	183	635	4758	4123
6	25	110	650	540
7	19	130	494	364
8	14	93	364	271
10	167	1436	4342	2906
11a	52	305	1352	1047
11b	31	792	806	14
13a	63	1185	1638	453
13b	48	362	1248	886
14	47	317	1222	905
Total	**986**	**8844**	**25636**	**16792**

Table 5:2. Shows the distribution of fish vertebrae, the MNI, expected amount of vertebrae and the deficit in the of Tortoise Cave sequence.

5.1:4: The fish bone assemblages in relation to environmental changes in the Verlorenvlei

The fish results show that during the accumulation of layers 14 to 11b, eight taxa of fish were captured. Four of these species, the elf *Pomatomus saltatrix*, kob *Argyrosomus hololepidotus*, dassie *Diplodus sargus capensis* and steentjie *Spondyliosoma emarginatum*, are casual visitors to estuaries but often enter tidal lagoons (Table 5:1).These species are not dependent on estuaries during their juvenile stages of life in the sense that *Mugil* and *Lithognathus* are, and would not enter coastal water bodies that regularly close down. The prominent position of the white stumpnose *Rhabdosargus globiceps* in these assemblages is entirely consistent with this scenario.
Above layer 11b, probably dating to some time after 4200 years ago, the dassie *Diplodus sargus capensis* disappears from the sequence, whilst the sea catfish *Aries feliceps* becomes relatively common in the samples. This indicates that the Verlorenvlei is still regularly open, though less permanently so, and starting to close down seasonally. There is a stronger presence of species that utilise estuaries as nursery grounds at this time, species such as the flathead mullet and white steenbras, which may point towards the middle reaches of the vlei being used as the main fishing habitat.
These observations are consistent with the idea of a gradually lowering sea level, but offer little support for any oscillation in sea level. Such lowering is supported by the change to the fish assemblages from layers 4 to 1b, which mark the closure of the estuary and the onset of the present coastal lake conditions that prevail in Verlorenvlei today. In layers 1b to 4 fish bone assemblages are dominated by the white steenbras and flathead mullet, with the white stumpnose much less common than earlier in the sequence. This impoverished fauna is entirely consistent with a regularly closed, intermittently open situation such as prevailed before the recent building of causeways in the vlei. The presence of hottentot *Pachymetopon blochii* in the uppermost layers could be a consequence of the collapse of Verlorenvlei as an active estuary and the use of the coast as an alternative fishing habitat.
The changes in the fish composition at TC seem broadly to support Jerardino's (1993) scenario derived from shellfish analyses, in reflecting

the long term closure of what once was an open, tidal inlet. The dassie *Diplodus sargus capensis* appears only in the lower deposits from 11b to 14 and, although juveniles occur mainly at sea, some tend to enter estuaries but are more common in lagoons (Wallace *et al.* 1984). It would appear that at least five species elf, kob, sea catfish, steentjie and dassie which are casual visitors to estuaries but more common in lagoons have been captured quite regularly in these layers. Their presence may reflect lagoon conditions that allow them to enter Verlorenvlei freely. If the transition from this lagoon condition to the present closed lake was oscillatory, as suggested by the shellfish evidence, it is possible that the fish assemblage patterns may not be sensitive enough to register these minor events.

5.2: SPRING CAVE (SC)

Spring Cave is a large cave located midway between EBC and TC, high up just below the Baboon Point escarpment. It overlooks the Elands Bay village and the mouth of the Verlorenvlei (Figure 4:1), and faces in a north-westerly direction. In the back of the cave on the western side, is a spring that used to supply the village of Elands Bay with fresh water, hence the name Spring Cave. The presence of the spring has created wet conditions in the western part of the cave and is partly responsible for the selection of the dryer eastern part of the site for excavation. In 1984 Yates, Manhire and Halkett (unpublished observations) excavated two separate square metres, D9 near the rear and I9 further forward, to test the deposits for confirmation of the occupation gaps found in EBC and TC. Another objective was to establish whether it would be worthwhile to launch a larger expedition to excavate SC.

5.2:1: Stratigraphy

The results of their excavation revealed sequences of about seventy centimetres in the rear and one hundred and thirty centimetres toward the front. The stratigraphy was subdivided on the basis of shell fragmentation and content, as well as by the soil and ashy matrix which separated some of the units, and dated with 6 radiocarbon dates. Towards the rear of the cave, in square D9, charcoal samples collected from two units in the 70 cm

of deposit gave ages of 460 ± 40 BP (Pta 4062), 22 cm below the surface, and 840 ± 50 BP (Pta 4042) at 60 to 70 cm, near bedrock. Both are associated with pottery. All units in the rear square are dominated by limpet, *Patella* spp. shells.

Cross correlation was possible between the two squares because of some common stratigraphic features. In square I9 four radiocarbon dates have been obtained, ranging from 1150 ± 50 BP (Pta 4035) some 30 to 40 cm below the surface to 3890 ± 60 BP (Pta 6226) in a massive organic sand layer, the lowest occupation horizon recorded, some 130 cm below the surface. The uppermost date is the lowest to be associated with limpet-dominated shellfish assemblages and pottery,

whilst the lower three are associated with large numbers of black mussel, *Choromytilus meridionalis*, and no potsherds. This pattern indicates that the first occupation at the site began after the second hiatus registered in the EBC sequence, and shows good correlation with the shellfish patterns at both EBC and TC.

5.2:2 Fish assemblage

The fish remains from the two squares analysed gave an MNI of 69 and revealed a range of eight taxa plus two unidentified species (Table 5:3). The most common taxon in the assemblage is white steenbras *Lithognathus lithognathus*, followed by flathead mullet *Mugil cephalus*. Although the sample is small, some inferences can be made regarding the fish from this site, particularly when compared with other sites in the vicinity of Verlorenvlei. Layer 5 at SC resembles layer 10 at TC and package 4 in the EBC sequence, in terms of the diversity of taxa. In all three instances the range of taxa includes species that do not enter estuarine or lagoonal environments, species such as the hottentot *Pachymetopon blochii* and galjoen *Coracinus capensis*, suggesting that during the accumulations of these deposits, coastal as well as estuarine fishing took place. Layers 2, 3 and 4 are almost identical in species range to that of layers 1b and 2a from TC. Both sites reflect a dominance of white steenbras and flathead mullet in the fish samples, which strengthens the argument put forward earlier about the closure of the estuary during this period, and the utilization of a closed mouth estuarine system.

SPRING CAVE

TAXA IDENTIFICATION

Layers	1	2	3	4	5	6	TOTAL
white steenbras *Lithognathus lithognathus*	0	9	12	5	10	2	38
flathead mullet *Mugil cephalus*	0	3	4	0	3	2	12
white stumpnose *Rhabdosargus globiceps*	0	0	1	0	4	2	7
elf *Pomatomus saltatrix*	0	0	0	0	1	0	1
galjoen *Coracinus capensis*	0	0	0	0	2	0	2
cape kob *Argyrosomus hololepidotus*	0	1	0	0	0	0	1
sea catfish *Arius feliceps*	0	0	0	0	2	0	2
hottentot *Pachymetopon blochii*	0	1	0	1	0	0	2
Unidentified sp. No 1	0	0	0	0	1	0	1
Unidentified sp. No 2	0	0	1	1	1	0	3
TOTAL	0	14	19	7	23	6	69

Table 5:3. The distribution of fish taxa through the stratigraphic sequence of SC near Elands Bay on the west coast of South Africa.

Layer 1 at SC has no fish and points to a complete breakdown of Verlorenvlei as a fishing habitat and the significant decrease in the importance of fish in the dietary package of prehistoric people at Elands Bay.

5.2:3: Fish vertebrae

At SC only 820 vertebrae have been recovered, whereas the MNI counts indicate that 69 fish have been identified on cranial bones. The expected number of vertebrae is 1794, giving a deficit of 974 or the equivalent of 37 fishes, more than 74% of the total fish identified at the site (Table 5:4). From these results it would seem that the same processing strategies practised at TC, as well as at EBC in the later Holocene deposits have also been employed at SC.

5.3: Diepkloof Rock Shelter

Diepkloof is a very large cave situated some 16 km from the coast, 120 m above the river on the left bank of the Verlorenvlei. The mouth of the cave faces north-east and offers substantial views up and down the river valley as well as across the sandveld to the north. The cave chamber was created when large blocks of the roof were dislodged and came to rest in front of the entrance creating an enclosed area of about 200 square metres behind them. The distribution of ash and bedding grasses in the upper deposits is very similar to that discovered at inland sites in the Olifants River valley and further east (Parkington and Poggenpoel 1971, 1987; Kaplan 1984; Anderson 1991). Around the back wall of the cave, just below the surface, wads of bedding grass could be seen covered by a thin film of dust. The central part of the cave floor was covered with large amounts of dassie, sheep and goat dung underneath which a large ashy deposit was uncovered in the centre of the cave floor.
Three dates have been obtained on materials from the grass units.

Spring Cave SP

Sq. D9		**Vert.**
Layer 1	Ash I-IV ; [Hearth below organic loam]	
	Organic Midden I-II	
Layer 2	Organic Loam	11
	Shelly Loam	
	HBSL (Hearth below shelly loam)	
	Vol	2
Layer 3	Organic Midden I-II	
	Dark Midden I-II	131
	Dark Brown Midden	5
Layer 4	Brown Soil/Dark Loam with Shell	
	Soil with shell	
Total		**149**
Sq. I 9		
Layer 1		
	Surface	
	HBS	
	Yellow Midden	
	Base of Yellow Midden	
Layer 2	HBBYM/ Midden Alpha	
	Bravo	32
	Charlie	56
	Delta	
Layer 3	Echo	
	Foxtrot	89
Layer 4	Roots	27
	Grass	
Layer 5	UDF	291
	All Black	
	Black midden	65
	Below Black Midden	61
Layer 6	Next Black I	50
	,, ,, II	
	,, ,, III	
	,, ,, IV	
Total		**671**

Table 5:4. The distribution of fish vertebrae in Sq. D9 and I9 at Spring Cave (SC).

The uppermost wad of bedding located in the western rear corner of the cave gave a date of 1050 ± 85 BP (GaK 4597), and a very similar age, 900 ± 50 BP (Pta 1056), has come from charcoal in a small hearth in the grass unit a few metres away. Grass from a different bedding patch right at the back of the cave gave a date of 390 ± 30 BP (Pta 1055).

These dates fall in the same time range as those from other sites with bedding grass materials preserved in the Olifants River valley and further east, such as Renbaan Cave (Kaplan 1984; 1987), De Hangen (Parkington & Poggenpoel 1971) and Andriesgrond (Anderson 1991). Although no shell middens had accumulated in the site, an amount of 4,5 kg of broken marine shell was retrieved from the deposits. The most common shellfish recovered was the black mussel *Choromytilus meridionalis*, along with a few *Patella* shells. Marine shell is commonly found in inland sites but never in such quantities as to suggest that they were foodwaste. The small number of marine elements found at Diepkloof, such as crayfish mandibles and sea bird bones, seems to indicate that occasionally marine foods were transported inland from the coast to the site. At the same time fish were also caught by the inhabitants, though whether they were caught at the coast or in the river is the point at issue. Two fish species have been identified in association with the Later Stone Age deposits. These are white steenbras *Lithognathus lithognathus* and flathead mullet *Mugil cephalus*. The white steenbras identifications were made on maxillaries and dentaries, the mullet have been identified on parasphenoids and supra-occipitals. The fragmentary nature of the bone made it difficult to measure length frequencies, but a MNI on the above named bones indicates that the white steenbras is the more common of the two species in the site. Seven white steenbras were identified from the bedding units and five from the hearth area. One of the flathead mullets came from the bedding and one from the surface.

The fish sample is small compared to EBC and TC, but the presence of only white steenbras and flathead mullet in the deposits is surely significant. Since both species can tolerate low salinities and have the ability to penetrate into almost fresh water conditions (Mehl 1973; Wallace 1975), I suggest that they may well have been caught in the upper reaches of the vlei below the cave.

5.4: Conclusion

Fish assemblages recovered from the archaeological sites in the Verlorenvlei area reported on in this study contain the earliest dated evidence of marine and estuarine fish exploitation along the south-west coast of South Africa. The earliest fish assemblages from EBC represent exploitation of fish resources near the mouth of the vlei, when mouth was some distance to the west of its present position.

The combination of a riverine setting and a lowered sea level led us to believe that the first appearance of fish in the sequence may have been captured in a riverine habitat (Poggenpoel 1987). Re-analysis of the fish bone with closer attention paid to certain body parts has confirmed that the flathead mullet *Mugil cephalus* in the lower deposit was at first wrongly identified. The species now recognised, the southern mullet *Liza richardsoni*, cannot tolerate low salinities and therefore confirms that fishing took place in the lower reaches of the estuary some kilometres to the west. The high incidence of vertebrae compared to cranial elements in these times, packages fourteen and fifteen, seems to support the hypothesis that transporting of processed fish took place between the coast and Elands Bay. The heads were cut off and discarded at the coast and the trunk parts of the fish were taken to EBC some distance inland.

The fish assemblage from TC shows a pattern of certain taxa dominating various parts of the sequence in a manner different from that at EBC. This may well reflect the utilization of a different part of the estuarine system as a fishing habitat. At EBC the estuary mouth may have been exploited, while at TC it was the middle reaches of the estuary.

The low incidence of vertebrae compared to cranial elements throughout the deposits of TC and SC seems to indicate that a procurement strategy similar to that seen in the earlier deposits of EBC may have been employed. But at these sites the heads of some fishes were removed and the trunks and vertebrae were prepared to take on journeys inland.

Biological indicators such as mammalian fauna and shellfish seem to substantiate the geomorphological evidence for sea level fluctuations during the late Pleistocene and early Holocene (Parkington 1976a; Klein & Cruz-Uribe 1987). Between 10 000 and 9600 years BP the bone frequency increases dramatically. It may represent continous occupation or a number

of short visits over a period of time, but at the same time it may relate to a mass trapping event. The size distribution of the dominant species, white steenbras *Lithognathus lithognathus*, indicates that approximately 56% of the fish captured have reached sexual maturity. Since research has shown that white steenbras do not spawn inside estuaries, the high incidence of adult fish in the assemblage may register a procurement strategy geared to capture fish at a time when they left the confines of the estuary for the open sea (Mehl 1973).

After the second hiatus at about 4300 years BP the drop in sea level reduced the chance of procuring estuarine fish, causing the occupants of EBC to include the coastal shore as an alternative fishing habitat. The taxa present in the deposit that follow the second hiatus suggest increased exploitation of marine habitats, as many of the species recorded do not utilise estuarine or lagoonal environments as living areas. Since the marine species do not continue through the rest of the sequence the presence of these fishes immediately after the hiatus may well be related to a cold upwelling episode.

The shrinking of Verlorenvlei after 3900 years BP through the lowering of sea level created even greater resource stress which caused hunter-fisher-gatherers to employ alternative food procurement strategies. The number of taxa drops from 9 to 2 and the MNI suggest that fishing has become a minor supplement to the overall dietary package. After the introduction of pottery at the site the Verlorenvlei resumed its present position and coastal lake conditions prevailed. Fewer marine fish entered the vlei since the interchange between sea water and vlei became restricted through a quartzitic sand bar which lies some 300 m above the vlei mouth (Miller 1987). The restriction of the quartzitic bar has altered the vlei system to such an extent that only two species of marine fish reside in the vlei to-day and they can enter or leave the confines of the vlei only during high spring tides (Grindley & Grindley 1987).

The overall pattern of fish exploitation in the Elands Bay area reflects a highly selective procurement strategy involving a greater knowledge of the behaviour and ecology of the fish that resided in the Verlorenvlei. Although the technology is not always clear the first fisher people at EBC knew about processing and storing fish for transportation. It is also evident that as the site catchment changed environmentally, the utilization of EBC

as a home base became more important. The interruptions of non-conformities in the sequence makes it difficult to follow the trend of cultural shifts through the sequence but the excavation has given us a glimpse at a segment of time in the lives of the hunter-fisher-gatherers in the Elands Bay area.

CHAPTER SIX

THE DYNAMICS OF THE LANGEBAAN LAGOON AND THE FISH ASSEMBLAGES FROM THREE OPEN COASTAL MIDDENS

This chapter deals with the ecology of the Langebaan Lagoon and the analysis of fish assemblages that have been excavated at three open midden stations: Stofbergfontein on the shores of the lagoon and two marine coastal sites, Paternoster and Duiker Eiland, located along the coast of the Vredenburg Peninsula north of Saldanha Bay (Figure 6:1).

6.1: The Langebaan Lagoon

The Langebaan Lagoon is really an inlet of the sea rather than a lagoon, and is partly sheltered by the Churchhaven Peninsula south of Saldanha Bay. The lagoon stretches for about 15 km in a south-easterly direction and has a water surface area of approximately 9 km^2 (Flemming 1976, 1977). The mouth of the lagoon opens to a wave sheltered southern part of Saldanha Bay and is controlled by the granite outcrops that divide the outlets into two separate channels.

6.1:1: The ecology of the lagoon

The present ecology of the lagoon system is dominated by a number of features such as wave action, current speed, tidal movements and consistency of salinity (Branch *et al.* 1976). The tidal range is approximately 1.5 m and current speeds of five knots have been recorded (Day 1959). The wave action decreases towards the head of the lagoon, and oceanic swell is slight. Water temperatures vary from cool and uniform at the mouth to warm and variable at the head.

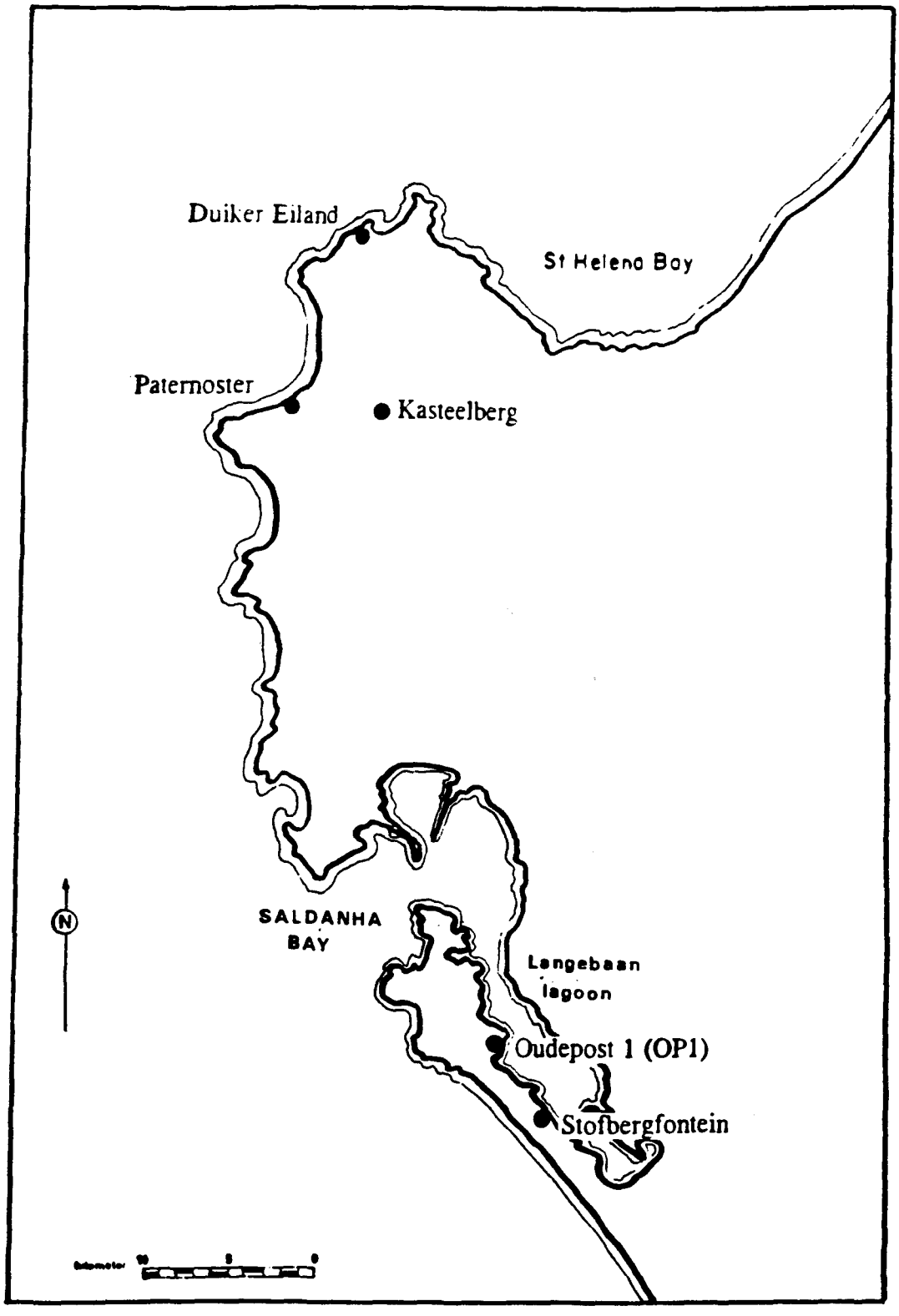


Figure 6:1. The location of archaeological sites on the Vredenburg Peninsula and at Langebaan Lagoon on the west coast of South Africa.

Salinities and temperature reach a peak at the head of the lagoon during the latter part of summer (Shannon & Stander 1977). The abundance of rocky shore intertidal fauna decreases up the lagoon, where decreased water movements allow siltation and smothering to take place. Sandy beach fauna increase in biomass towards the head of the lagoon and subtidal fauna reach peak diversity in species within the channel (Branch *et al.* 1976). The majority of edible shellfish are found in the surf zone near rocky shores at the coast. Only a few sand mussels inhabit the lagoon which has mainly sandy shores.

6.1:2: The modern fish population of the lagoon

The modern fish population of the Langebaan Lagoon is dominated by southern mullet (Pollock & Christie 1976), detritus feeders that move in and out of the lagoon with the rise and fall of the tide. At the head of the lagoon the reed beds act as a nursery ground and mature southern mullet come close to the shoreline at high tides where they are captured in large numbers (Robertshaw 1979b). These fishes are caught with gill nets presently, although other species belonging to the Sparidae family such as the dassie *Diplodus sargus capensis*, white steenbras *Lithognathus lithognathus*, white stumpnose *Rhabdosargus globiceps,* steentjie *Spondyliosoma emarginatum* and occasionally the Cape kob *Argyrosomus hololepidotus* and elf *Pomatomus saltatrix* are caught with handlines and rods.

Occasionally sparid fishes like the ones mentioned above are caught with nets from the beach (trek nets), but on the whole they are not common as southern mullet throughout the year. The lesser guitarfish *Rhinobatus annulatus* is very common and occurs throughout the lagoon in shallow water. It has a habit of camouflaging itself under the sand close inshore waiting for prey and sometimes they do not respond fast enough to the receding tide and get stranded. The spotted gully shark *Mustelus nigropunctatus* occurs mainly in the deeper channels of the lagoon, while other common cartilaginous species include the skate *Raja clavata*, the dogfishes *Malaelurus natalensis* and *Poroderma pantherium* as well as the sting rays *Dasyatus pastinaca* and *Myliobatus aquila* (Pollock & Christie 1976).

6.2: Stofbergfontein Midden

This site is located on the southern shore of the Langebaan Lagoon near the village of Stofbergfontein on the Churchhaven Peninsula (33° 09'S, 18° 04'E), (Figure 6:1), (Robertshaw 1979b). A small scatter of shellfish lay stratified in a deep lime rich deposit about 10 m above the lagoon high water mark. The excavation area enclosed approximately 3 m^2 and was subdivided into two stratigraphic units of which only one horizon was accepted as *in situ*. This unit yielded most of the shellfish and fish remains where as the other unit was interrupted by a sterile dune sand which made it difficult to see if it was contemporary or later. Both units had pottery associated and it was assumed that they both belong to occupations not older than 2000 BP. A radiocarbon date of 1550 ± 55 BP (Pta-1903) for the main unit seems to confirm this (Robertshaw 1979b). This date seems to indicate settlement on the shores of the lagoon after the stabilisation of the present sea level and the closure of the Kraalbay channel (Flemming 1977).

The abundance of cartilaginous fish presently found in the lagoon may have been exploited in the past, but the internal skeletal remains rarely survive in the archaeological record. The large shellfish component at the site indicates coastal foraging as many of the shellfish species do not occur in the lagoon.

6.2:1: Fish assemblage

The fish species identifications were first made on premaxillaries and dentaries, which resulted in a total MNI of 77 individuals (Table 6:1). Only four species could be positively identified on mandible counts and these did not include the southern mullet. The absence of southern mullet in the sample prompted me to re-examine the fish bone, since the present annual catch of fish in the lagoon yields approximately 80% southern mullet (pers. comm. G. Branch). By separating all cranial parts it was evident that the basioccipital and atlas vertebra bones survived more frequently in the case of mullet (Poggenpoel 1984). By using these bones as a means to count individuals the number surpassed counts made on mandibles. A total of 15 566 elements was identified of which 13 972 were vertebrae.

Stofbergfontein Midden

species

white steenbras *Lithognathus lithognathus*	56
white stumpnose *Rhabdosargus globiceps*	3
hottentot *Pachymetopon blochii*	11
harder *lisa richardsoni*	6
elf *Pomatomus saltatrix*	1
TOTAL	**77**
the number of *Lisa richardsoni* counted on basioccipitals is	277
NEW TOTAL	**348**

Table 6:1. A list of species identified at Stofbergfontein Midden

The total MNI for the site was 348 which gave a surplus of 4924 vertebrae or the equivalent of 189 fish. The presence of large quantities of shellfish suggest coastal exploitation and the presence of hottentot in the fish assemblage points to fish caught at the coast having been brought to the site. Some may have arrived without their heads, hence the low number of cranial elements in the deposit of Stofbergfontein. The fish fauna of the Stofbergfontein midden compares well with the modern day fish from the lagoon (Pollock & Christie 1976), with the exception of hottentot *Pachymetopon blochii* which does not occur in the lagoon. The most common fish taken at Stofbergfontein was southern mullet; this became clear after the experiment mentioned earlier was conducted. This high preponderance of southern mullet may be related to the use of a mass trapping technique. Presently large amounts of southern mullet are caught with gill nets in the lagoon and similar catches could have been achieved through a mass trapping method such as the use of fishtraps. Three such traps have been located in the vicinity, one at Kreeftebaai and two in the lagoon, one of these being just below the site at Stofbergfontein.

Although the site at Stofbergfontein is situated on the shores of the lagoon, much of the food residue found in the midden was obtained at the open coast (Robertshaw 1979b). The attractions of the lagoon rather than the coast for settlement may have been the proximity to freshwater and for monitoring the fishtraps. Freshwater is only available at a few points on the peninsula and none are near the coast. The historic Fort Oudepost 1 (OP1) erected by the Dutch in 1669 was placed near such a spring in Kraalbay, perhaps the same water point used by the Stofbergfontein occupants a thousand years earlier (Schrire 1984, 1987, 1995).

It is interesting to note that quite a number of sea-birds such as comorants and penguins, are present in the faunal sample, but none of the wading birds that normally congregate along the banks of the lagoon was ever caught in prehistoric times. It is possible that people's technological skills were not geared to cope with wading birds and that the lagoon was only used as a fishing habitat. This in turn created certain constraints for settlement along its shores, and it became necessary to increase site territory to include stretches of the rocky coastline with shellfish and other edible sea foods.

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6.3: Paternoster Midden

Paternoster is a small hamlet on the Vredenburg Peninsula along the west coast between Saldanha Bay and Stumpnose Bay (32° 48'S, 17° 53'E), (Figure 6:1). The coast near Paternoster is characterized by a rocky shore in the vicinity of the midden with occasional sandy bays to the north and south. The shore immediately in front of the site is rather shallow. In some places the kelp beds are visible through the surface waters between the boulders.

A small open midden was discovered behind the crayfish factory at Paternoster some 11 m above sea level, during a archaeological survey conducted by Francis Thackeray and Mike Cronin in early 1970. The site was later excavated by Robertshaw and myself in 1975 (Robertshaw 1977). The midden was covered by a recent sand dune, capped with shrub vegetation. Some erosion on the northern slope of the midden revealed an *in situ* deposit of approximately 75 cm in depth. A 3 m cutting was made along the exposed face to establish the vertical stratigraphy, and from this section a 6 m^2 area was excavated from the surface down through the deposit into the underlying sterile dune below. Several horizons were exposed, distinguished on the basis of relative abundance of shellfish, degree of fragmentation and changes in soil matrix. These were excavated separately. During the analysis of the cultural and faunal material some horizons were combined to create the 6 layers (Figure 6:2). The accumulation of cultural material is dominated by marine shells. Layer 1, the unit below the surface, is a pronounced band of shells dominated by the black mussel *Choromytilus meridionalis*. Layer 2 is a sandy unit with large amounts of *Patella* spp. (limpets).

Three horizons originally separated during excavation have been combined to form layer 3. They are all enclosed in a greyish soil with dominant *Patella* shells. In layer 4, the shells are highly fragmented and compacted and are mainly *Choromytilus meridionalis*. In layer 5 the shells are loose and associated with a blackish soil and in layer 6 the deposits become browner in colour with occasional shells present.

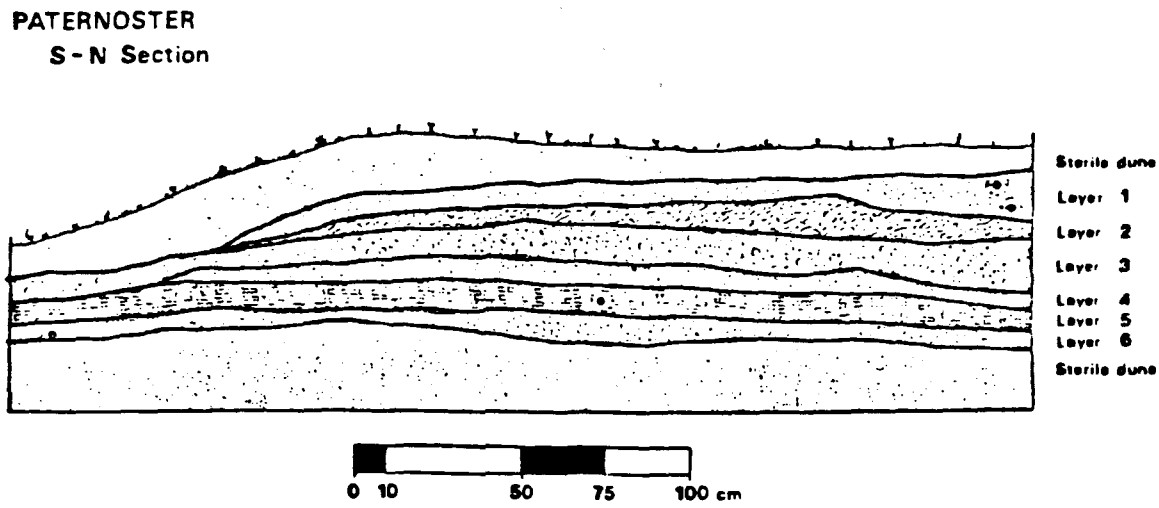

Figure 6:2. The stratigraphic sequence of Paternoster shell midden (after Robertshaw 1977).

No pottery was discovered below layer 2 and it appears that the date of 3100 ± 60 BP (Pta 1717) for layer 5 is probably correct. Two other dates from layer 2 1870 ± 50 BP (Pta 1615) and 855 ± 45 BP (Pta 1616) from layer 1, indicate that a short hiatus existed between the pottery bearing units and layer 5.

6.3:1: Fish assemblage

The excavated material was passed through two sieves, one of 12 mm and the other 3 mm mesh size. All artefactual and faunal remains were retrieved from both sieves and marked according to metre squares and horizons from which they were excavated. The fish bone retrieved was analyzed by body part and species identification was made on mandibles. Only one species of fish is represented in the sample, the hottentot *Pachymetopon blochii*. The number of elements identified at the site is 1930 of which 1116 are vertebrae. Seventy fishes have been identified on cranial elements, but vertebrae are under-represented in the site by as many as 704 vertebrae or the equivalent of 27 fishes.

The distribution of fish bone per layer can be seen in Figure 6:3. The most common cranial bone in the sample is the entopterygoid, which has been used to calculate the MNI for the site. To investigate the possibility of increasing the MNI count, it was decided to divide the entopterygoids into left and right and to measure sizes. The left and right bones of a similar size were then paired to represent one individual per pair, and all the unpaired left and right bones were assumed to represent separate individuals.

This method of analysis not only ensured a high MNI count but also gave the opportunity to translate the fish bones into fish lengths and meat weights. The basi-occipitals, atlas vertebrae, mandibles and entopterygoids of 116 comparative hottentot fish of both sexes were measured and the average weight and fork length were calculated. This enabled us to arrive at a average mean size and fish weight for the fish sample caught at Paternoster and Duiker Eiland (Figure 6:4).

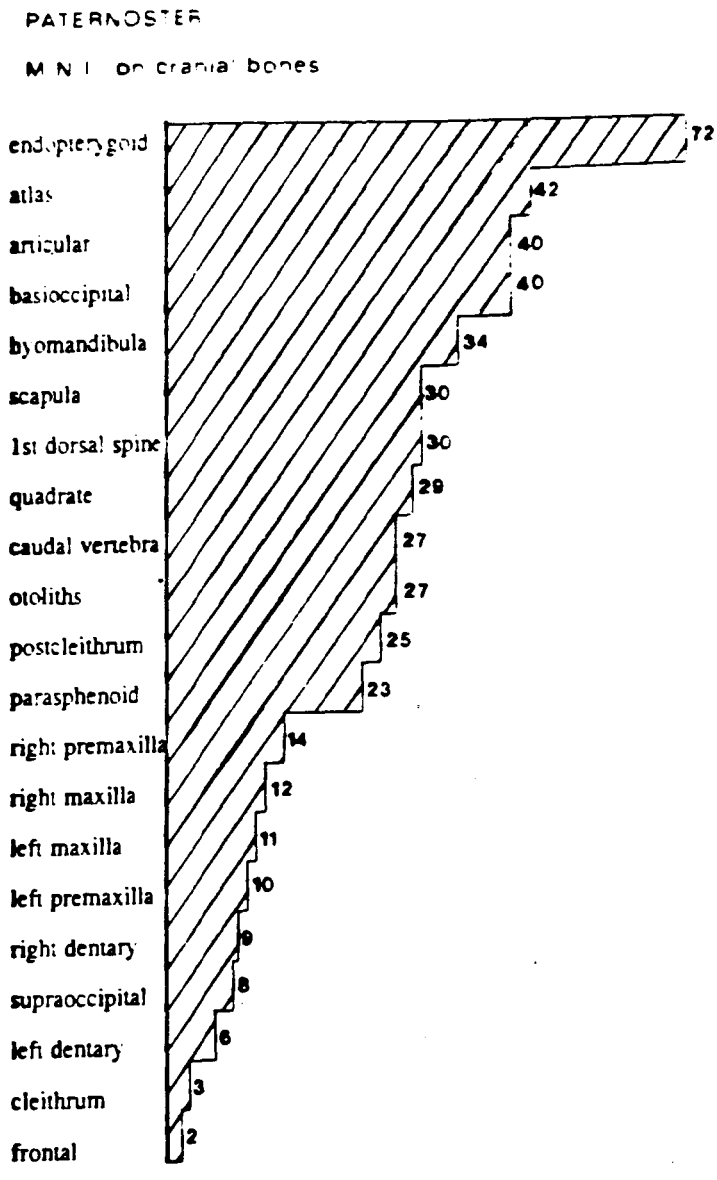

Figure 6:3. The MNI calculated on various cranial elements for the species hottentot *Pachymetopon blochii* at Paternoster.

hottentot *Pachymetopon blochii*

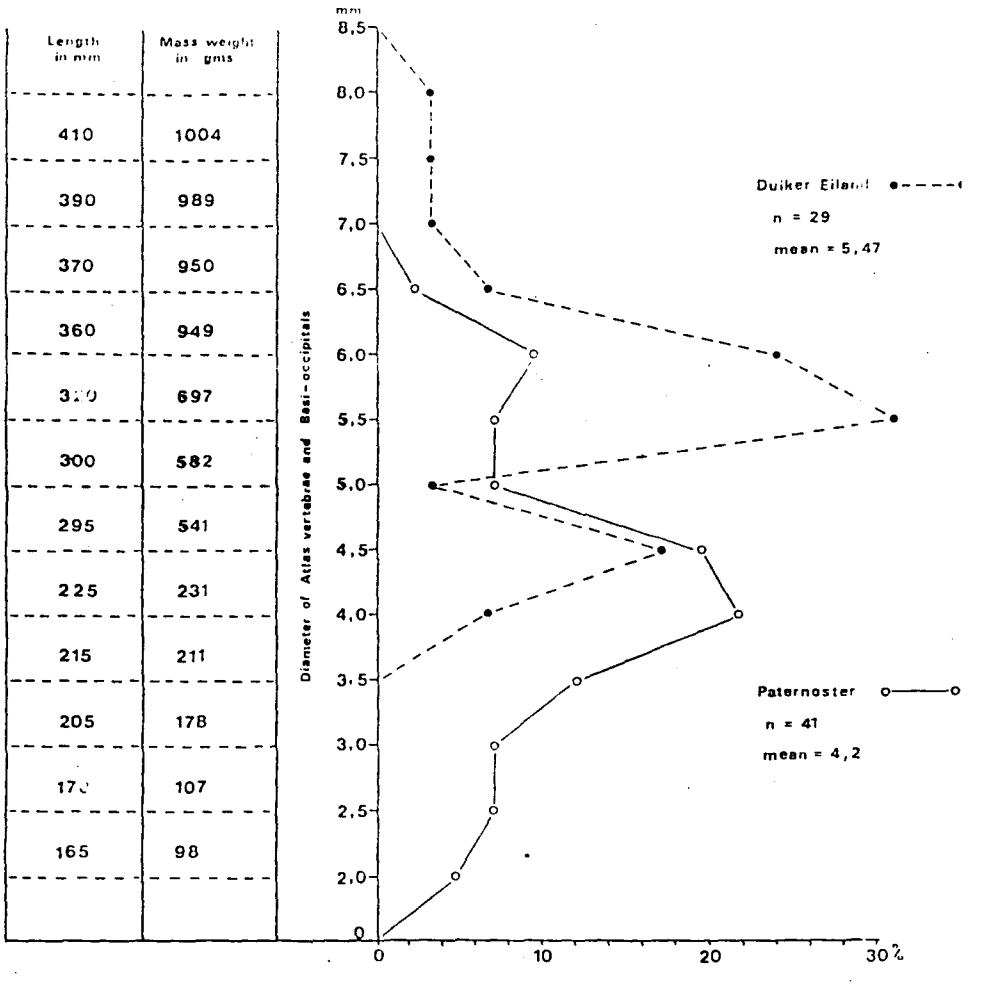

Figure 6:4. The length and weight measurements coralated with atlas and basioccipital bones of hottentot *Pachymetopon blochii* from Duiker Eiland and Paternoster.

6.4: Duiker Eiland Midden

This site is located amongst unconsolidated sand dunes on the farm Duiker Eiland, in the north-western part of the Vredenburg Peninsula some 9 km north of Paternoster (32° 43'S, 17° 55'E) (Figure 6:1) (Robertshaw 1979a).

The immediate coastal morphology surrounding the site suggests a steeper shore with sharp buttresses in places, north-west of the site which supports a considerable shellfish population. To the west the granite basement on which the recent sand dunes rest drops off immediately at the beach front indicating that it is somewhat deeper in this area than at Paternoster. An archaeological survey has revealed many sites which included stone circles and open shell scatters. One of these shell scatters, exposed through recent dune activity some 5 m above sea level approximately 100 m from the shore, was selected for excavation. An area of 3 m^2 was excavated down to a depth of 12 cm. The deposit was subdivided into 3 layers of which the second layer provided most of the faunal remains. On the surface some pottery and shellfish was exposed and yielded a radiocarbon date of 1700 $\pm$ 50 BP (Pta 1581). No pottery was found below the surface, although the below surface units seemed contemporary and layer 2 gave a date of 1930 $\pm$ 70 BP (Pta 1554) (Robertshaw 1979a).

6.4:1: Fish assemblage

Fish bone recovered from the site represents two species, the hottentot *Pachymetopon blochii* and the southern mullet *Liza richardsoni*. The total number of fish identified on mandibles were 17 hottentot and 9 southern mullet on parasphenoids. On the otolith count for hottentot and parasphenoids for southern mullet the number was increased to 46 fish. A total of 1229 elements was identified of which 732 are vertebrae. The vertebrae represent a shortfall of 19 fishes recorded on cranial elements, which suggest that 497 vertebrae was taken elsewhere. As the site is completely exposed on the side of a deflation hollow, most of the faunal remains on the surface have become sun bleached and broken into unidentifiable fragments. The exposure of the faunal material to the natural

elements may have caused faster deterioration of faunal remains and this may also be the reason why the most common cranial element is the otolith (Table 6:2). The otolith is made up mostly of calcium carbonate and aragonite which survive well. By counting left and right otoliths the MNI for hottentot was increased to 37. The atlas vertebrae and the basi-occipitals of the hottentot fish were measured and indicated a mean fish fork length of 32 cm, which is larger than those found in the Paternoster sample. The difference in size of the hottentot in the two samples may relate to the depth of the water along the shore. As indicated earlier, the water in the vicinity of Duiker Eiland is deeper than at Paternoster and larger hottentot are always associated with deep water that has large kelp beds. The number of hottentot has always been low in sites from the Elands Bay area, (at Elands Bay Cave three out of a total of 1814 identified fish (Table 4:1), at Tortoise Cave two out of 896 (Table 5:1) and at Spring Cave three out of 69 (Table 5:2). Avery (1977) analyzed the bird remains from Paternoster, and suggested that the site was occupied during summer, based on the presence of large quantities of young sea-bird bones in the faunal samples.

6.5: Conclusion

The fish assemblages from the three sites examined in this chapter reflect the utilization of the lagoon and the open coast. Although the site of Stofbergfontein is located on the shores of the Langebaan Lagoon, the shellfish and faunal elements present suggest that the coast played a major role in the exploitation strategies of the occupants. The high incidence of vertebrae also points to fish being brought to the site, since there are more vertebrae present than at other sites which are close to the coast. The exploitation of the coast is supported by the presence of large quantities of marine shells and the presence of the hottentot fish *Pachymetopon blochii*, a marine species.

At Paternoster and Duiker Eiland the fish assemblages indicate that there is a deficit in the number of vertebrae at the sites which points to the trunk regions of some fishes having been removed.

Duiker Eiland Midden

Stratigraphy	hottentot *Pachymetopon blochii*	southern mullet *Liza richardsoni*
Surface	4	0
Bone lens	7	4
Jackie		
Christine	6	5
Total	17	9

counted on premaxillae and dentaries

Unit Cranial element	Sur	BL	J	C	Total
atlas	13	7	6	10	36
other vert	170	362	47	253	732
quadrate	18	17	3	20	58
articular	9	13	3	10	35
entopterygoid	20	10	3	16	49
supraoccipital	12	3	0	3	18
basioccipital	12	8	3	11	33
caudal vert.	4	12	5	10	31
frontal	0	5	0	1	6
parasphenoid	6	13	1	9	29
shouldergirdle	10	5	0	15	30
opercular	2	4	0	4	10
otolith	44	3	3	23	73
cliethrum	4	9	1	7	21
postcleithrum	4	8	0	12	24
anal spine	3	6	1	4	14
hayomandibular	13	9	0	8	30
Total	**344**	**491**	**76**	**416**	**1229**

Table 6:2. The identification fish species and distribution of fish elements from Duiker Eiland.

Both assemblages are dominated by the species hottentot and as we have seen earlier, in Chapters Four and Five this species is not common at the Elands Bay sites. From these results it would seem at first glance that low numbers of hottentot are associated with winter occupied sites rather then summer sites. It also seems that large numbers of hottentot present in archaeological sites on the west coast indicate summer occupation, but on the other hand it may only reflect the use of different fishing habitats, i.e. estuarine or marine. The hottentot is a marine species that does not enter estuarine or lagoonal environments, is not migratory and tends to be endemic to certain areas. Evidence from the Elands Bay sites suggests strongly that the Verlorenvlei was utilized as a fishing habitat hence the low incidence of hottentot in the assemblages. At Paternoster and Duiker Eiland there is no estuary within the immediate vicinity, and the exploitation of the marine habitat is reflected by the overwhelming amount of hottentot in the coastal assemblages. Although both shorelines in the vicinity of the sites are dominated by boulders and kelp beds which are the favoured habitat for hottentot, the size of hottentot that can be caught in those areas seems to be affected by the depth of the near-shoreline. Since both sites are close to the coast the analysis of the fish assemblages indicate that cranial elements are dominant at both sites. The low incidence of vertebrae may be an indication that sites in close proximity to the coast are used as fish processing sites where fish are prepared to be taken inland as food for later consumption.

CHAPTER SEVEN

THE MODERN FISHING ACTIVITIES AND FISH ASSEMBLAGES FROM SELECTED SITES IN THE FALSE BAY AREA

This chapter relates to the fishing activities and habitat of False Bay and the fish assemblages excavated at two archaeological sites Smitswinkelbaai Cave (SWBC) and Rooiels Cave (RC) in the False Bay area.

7.1: False Bay

The Cape Peninsula has a number of large bays including Table Bay, Hout Bay and False Bay. The latter is surrounded by steep mountains in some places abutting directly onto the sea, forming part of the immediate foreshore. False Bay is a large square bay with sides of about 30 km (Grindley 1980; Heydorn and Tinley 1980). The entrance to the bay is wide, allowing for free interchange with the open sea, and therefore it cannot be regarded as an isolated entity but should be included as part of the wider coastal region. The steepness of the mountains is noticeable between Hangklip and Gordons Bay and in the Cape Point area.

More than eleven rivers discharge water into the False Bay embayment, but due to the pollution of urban, industrial and agricultural development, many of the river mouths and estuaries that existed in the past have lost their delicate balance of nutrient status. The imbalance that now prevails has affected the productivity of the estuaries and near shore nursery habitats of many fishes which are dependant upon a regular interchange of terrestrial and marine waters through the mouths. At the same time the impact of bridge construction, roads, man-made impoundments and dams are responsible for the congestion that hampers river outflow and for the trapping of silt and sand. In many instances the outflow of water has decreased to such an extent that some rivers have changed course and lost their productiveness as estuaries.

False Bay is located on the eastern shore of the Cape Peninsula. For some time it was accepted that the temperature of the bay has largely been influenced by the Agulhas Current in the Indian Ocean. More recent research has established that the warming is mainly due to its shallowness rather than the influence of the Agulhas Current (Atkins 1970; Cram 1970; Grindley & Taylor 1970; Grindley, 1980). The depth of the bay varies from about 80 m at the mouth at Cape Point to shallow water all around the fringes of the bay (Mallory 1970). In spring the water temperature becomes warmer in the north-eastern shallows, while a body of cold water remains in the middle of the bay (Atkins 1970; Cram 1970). In autumn rapid cooling takes place in the central areas of the bay and water entering from the Indian Ocean is warmer than that of the bay. The lowest temperature recorded in the bay is about 14° in the north-eastern area where an influx of cold freshwater is discharged from the Lourens and Eerste Rivers into the bay (Grindley 1980).

7.1:1: Fishing activities

Although the pelagic purse seine fishery is an important activity in South Africa only a few boats with seine net licenses are allowed to fish for bait in False Bay. Other boats from Hout Bay are only permitted to fish in False Bay from the 15th of January to the 30th of April (Newman 1980). The total pelagic quota for South Africa is 380 000 tons and approximately 10% of the total landings are in the False Bay area. The fish are not taken from a resident stock but come mainly from a large biomass of fish distributed widely around the coast. On occasions large shoals enter the bay which are exploited by the local fishermen.

7.1:2: Handline fishery

In the late seventies as many as 712 licensed motor boats, ski-boats and small boats were registered in the False Bay area. The main harbours from which they operated were Gordons Bay, Simonstown and Kalk Bay. During 1979 the total catch landed was approximately 1000 metric tons of line fish, the most important component being snoek *Thyrsites atun* (807 m tons), with hottentot *Pachymetopon blochii*, white stumpnose *Rhabdosargus*

globiceps and carpenter (silverfish) *Argyrozona argyrozona* the next most important (56 m tons) (Newman 1980). Other fish such as Cape yellowtail *Seriola lalandi*, kob *Argyrosomus hololepidotus*, geelbek *Atractoscion aequidens*, roman *Chrysoblephus laticeps*, red steenbras *Petrus rupestris*, white steenbras *Lithognathus lithognathus*, mackerel *Scomber japonicus* and sharks make up the other 137 m tons (Newman 1980).

7.1:3: Beach seine netting

During 1973 as many as 102 beach seine net licences were issued by the Department of Sea Fisheries. By 1980 the number was reduced to 92 and more recently only seven are still in operation in the bay (Yeld & Gubb 1993). This method of fishing is a traditional activity of the local people and the most common fish caught by this method is southern mullet *Liza richardsoni*. Sometimes white stumpnose *Rhabdosargus globiceps*, yellowtail *Seriola lalandi* and white steenbras *Lithognathus lithognathus* are also landed but, on the whole, southern mullet catches constitute approximately 2% of the western Cape southern mullet catch in any one year.

During 1991 an intensive, but as yet unpublished, study of the activities of the commercial trek fishermen was conducted by Bennett and Griffiths from the Marine Biology Research Institute at the University of Cape Town. Their conclusions were that from a total of 268 treks monitored 640 239 fish were caught, of which 87.3% were southern mullet. This was not always so, because at the turn of the century 83% of the fish by weight of the trekked fish was made up of fish normally taken by anglers, while southern mullet accounted for only 5% of the catch (Lamberth *et al.* 1995a, b, c). The emphasis gradually changed to targeting southern mullet as the conflict between anglers and trek fishermen mounted over a resource that was being over exploited (Lamberth & Bennett 1993).

7.1:4: Other fisheries

Since there are no statistical records available for rock angling and spear fishing, it is difficult to assess the affects these activities have had on the fish population in the near-shore areas. During the holiday season the

angling and spear fishing sports increase quite drastically and popular places where sedentary species live may become over exploited. At the same time most of the species targeted by these sporting activities are non resident in the area and so these activities may not be that detrimental to the national stocks.

Although more than twenty archaeological sites have been recorded in the False Bay coastal area, the fish remains from only four sites have been analysed, Smitswinkelbaai Cave (SWBC), Rooiels Cave (RC), Froggie Pond and the Posthuys at Muizenberg (Poggenpoel & Robertshaw 1981; Saitowitz 1981; Smith 1981; Poggenpoel & Riley in prep.). The reasons for this are, first, that not all the archaeological sites have faunal material (Oliver 1977) and, secondly, that some of the sites were excavated in the late nineteenth century when quantitative analysis of archaeological faunal remains was seldom done.

7.2: Smitswinkelbaai Cave (SWBC)

The site is located on the eastern side of the Cape Peninsula about 100 m to the south of a small bay and holiday hamlet after which it is named (32° 16'S, 18° 28'E) (Figure 7:1) (Poggenpoel & Robertshaw 1981). The cave is set in Table Mountain sandstone about 2 - 3 m above the high tide mark and at times of spring high tides sea water reaches into the entrance of the cave which makes the cave inaccessible for two or three hours. The shore immediately in front of the cave is rocky and boulder-strewn, supporting populations of various species of edible shellfish and a kelp forest. The cave itself is situated in a broken cliff which reaches a height of 100 m and access is only possible along the shore from the north. About 100 m north of the site is a small sandy bay into which a perennial stream flows.

Excavation was concentrated in an alcove on the south side of the cave where most of the undisturbed deposit appeared to lie. The surface of the *in situ* deposits sloped up towards the wall of the cave and thus the most complete sequence was obtained from Squares C4 and D4. The top three layers were not represented in squares C2 and D2. About 20 - 30 cm of disturbed overburden, possibly shovelled out of the centre of the cave, also capped the deposits towards the wall of the cave.

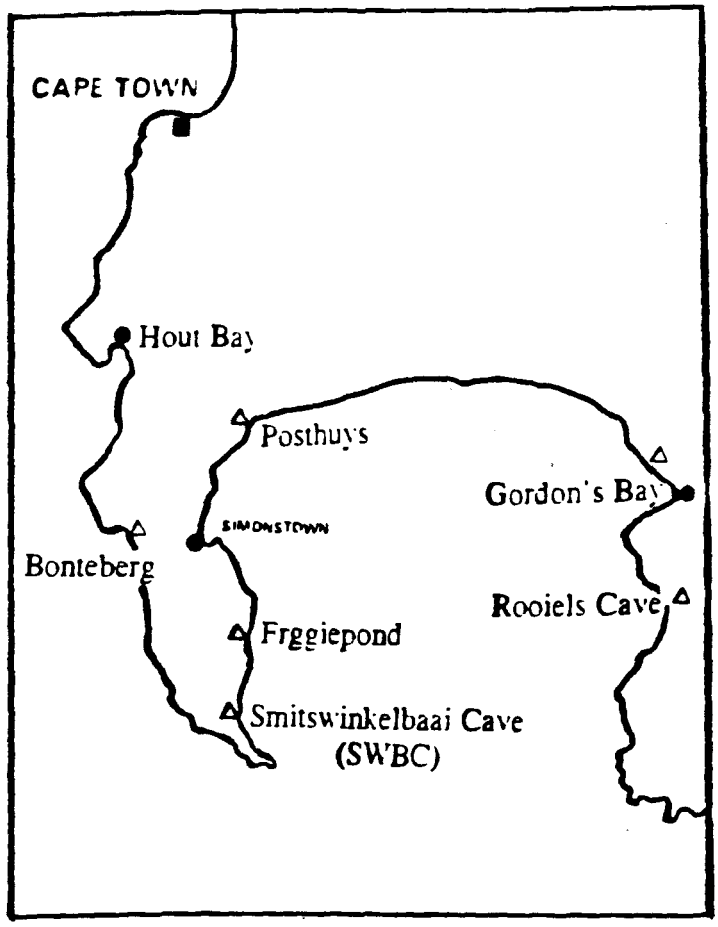

Figure 7:1. The location of excavated archaeological sites with fish bone assemblages along the False Bay coast on the Cape Peninsula.

Only square C3 was excavated down to bed-rock, while the other squares were dug to the base of layer 6. More than 30 statigraphic units were recognized during excavation on the basis of variations in shell content and degree of fragmentation, together with presence of harder surfaces and different soil matrices. On the assumption that certain units probably represent different facies of a single or limited number of occupations and in order to obtain larger samples for statistical analyses several units were combined, with the result that nine layers are recognized in all. All layers were shell middens with the exception of layers 7 and 9. Both of these layers contained some shell but were very damp, with greyish deposits with numerous hearths and much decomposed charcoal. Patches of clean beach sand occurred in layer 9 which rested directly upon a boulder beach. In square C3 the only hearth found in the deposit consisted of a circular area of about 50 cm in diameter, with no hearth stones at the interface between layers 3 and 4. A charcoal sample was removed from the hearth which gave a radiocarbon date of 1175 $\pm$ 35 BP (Pta 2200). Some of the charcoal recovered from layer 9 was also dated, to give a date of 1420 $\pm$ 35 BP (Pta 2198). The comparatively short timespan for the accumulation of the deposits reflects the rapidity with which substantial shell middens can be formed. With the exception of the middle layers 5, 6 and 7 all layers had pottery.

7.2:1: Fish assemblage

The fish remains recovered from the sieves were sorted into various elements and the identification of different taxa was accomplished by using premaxillae and dentaries. The MNI given in Table 7:1a have been derived from these bones, whereas, several body parts were used to provide the MNI counts reflected in Table 7:1b. The use of premaxillae and dentaries has led to the identification of 381 fishes but individual counts were increased by 37 through counting other body parts.

Fish are present throughout the deposit excavated at SWBC, and more than 56% of the total MNI were found in layers 3, 4 and 6. The most common species represented in the assemblage is hottentot *Pachymetopon blochii* followed by black musselcracker *Cymatoceps nasutus*.

	Overburden	Cleanings and Tramplings	Layer 1	Layer 2	Layer 3	Layer 4	Layer 5	Layer 6	Layer 7	Layer 8	Layer 9	Total	%
Hottentot *Pachymetopon blochii*	19	8	6	19	62	63	13	49	18	17	7	281	73.7
Hottentot species *Pachymetopon* sp.	—	—	—	—	1	3	—	—	1	2	1	8	2.09
Poenskop *Cymatoceps naosutus*	10	4	4	13	21	15	2	4	1	1	3	84	22.0
White stumpnose *Rhabdosargus globiceps*	2	—	—	2	—	—	—	—	—	—	—	4	1.04
Blacktail *Diplodus sargus*	—	—	1	1	—	—	—	—	—	—	—	2	0.52
Galjoen *Coracinus capensis*	1	—	—	—	—	—	—	—	—	—	—	1	0.26
White steenbras *Lithognathus lithognathus*	—	—	—	—	—	—	1	—	—	—	—	1	0.26
	32	12	11	33	84	81	16	53	20	26	11	381	99.35

Table 7:1a. The distribution of fish taxa identified on premaxillae and dentaries in the Smitswinkelbaai Cave (SWBC) sequence (after Poggenpoel & Robertshaw 1981).

Smitswinkelbaai Cave (SWBC)

Units	body part	MNI
Overburden	premax and dent	32
Cleanings & tramplings	premax and dent	12
Layer 1	parasphenoid	13
Layer 2	scapula	43
Layer 3	entopterygoid	105
Layer 4	premax and dent.	81
Layer 5	hayomandibular	20
Layer 6	entopterygoid	65
Layer 7	premax and dent.	20
Layer 8	premax and dent.	26
Layer 9	premax and dent.	11
Total		**418**

Table 7:1b. MNI counts generated by using the most common body part in each stratigraphic layer at Smitswinkelbaai Cave (SWBC).

Both species are present throughout the deposits but with a slight shift in abundance to 45% of the poenskop occuring in layers 2, 3 and 4. Other species are less frequent and appear randomly through the deposit. The low numbers makes it difficult to assess their importance in the assemblage.
All fish species present occur within the fishing habitat in front of the cave. The coast here is steeply shelved with some of the lower boulders in the water covered with brown mussels *Perna perna*, sea weeds and kelp. The fish were perhaps line fished rather than trekked or trapped in a tidal fishtrap. The small beach north of the cave is currently being used for trek fishing and less than 1 km south of the cave at Boordjiesdrift, a tidal fishtrap existed. None of the species commonly caught with treknets or in fishtraps are, however, present in great numbers in the fish assemblage, which points to another method of procurement. At least one 'fish gorge' was found, similar to specimens excavated at NBC (Klein 1972), EBC (Parkington 1972, 1976a) and Byneskranskop (Schweitzer & Wilson 1978). Since these gorges have only been found in archaeological sites associated with fish remains, it has been assumed that they were used for fishing.

7.2:2 Fish elements

The distribution of fish elements through the site indicates that the most common fish bones in the assemblage beside vertebrae are the entopterygoid and the parasphenoid. This is followed by the shoulder girdle which is a post cranial bone that could have been removed with the head during processing.

7.3: Rooiels Cave (RC)

The site is situated on the north bank of the Rooiels River some 29 km south, south-east of Gordons Bay (34° 18'S, 18° 49'7" E) (Figure 7:1) (Smith 1981). The site was first excavated by Divine and van der Byl in 1921 and a year later the excavation was continued by Barnard of the South African Museum. Towards the front of the cave Barnard left a 1 m balk between his and Divine's trenches. In 1979 Smith re-investigated RC and removed 3 m^2 of deposit in the front of Barnard's excavation (Smith 1981).

The deposit excavated by Smith revealed 23 stratigraphic units. The upper two units down to a depth of 22 cm were discarded due to disturbance. Bed-rock was reached at a depth of 2.6 m below the surface. Although the analysis of the cultural and faunal remains was restricted to only one square, square B2, fauna and shellfish are present throughout the deposits. A charcoal sample from unit 22 at the bottom of the sequence in Sq. B2 gave a date of 6100 $\pm$ 120 BP (Pta 3069) for the earliest occupation.
The examination of the cultural material indicates that there is a significant shift in formal tools in unit 21 to 23, but there are less obvious changes in the shellfish and fauna. It is interesting to note that in unit 21 the two dominant fish species, hottentot *Pachymetopon blochii* and black musselcracker *Cymatoceps nasutus*, are absent from the fish sample and may be related to a seasonal change of occupation. In Barnard's excavation a sterile humic layer was located towards the back of the cave, separating two distinct occupation horizons. This sterile layer was not encountered in the 1979 excavations conducted by Smith.

7.3:1: Fish assemblage

Only the fish remains recovered from the 1979 excavations have been analysed since the material from the previous excavations was not available for analysis. 34 342 elements were sorted and 10 taxa identified on premaxillae and dentaries which gave an MNI of 274 excluding layers 1 and 2. The MNI was in creased by counting other cranial elements to 418. The most common species in the sample is hottentot *Pachymetopon blochii*, followed by black musselcracker *Cymatoceps nasutus* (Table 7:2). Although the site is located on the banks of the Rooiels River the fish assemblage reflects a species composition that is dominated by marine habitat fishes. Estuarine species such as white steenbras *Lithognathus lithognathus*, white stumpnose *Rhabdosargus globiceps* and flathead mullet *Mugil cephalus* are extremely uncommon.

7.4: Conclusion

The fish excavated at RC compare well with SWBC and the two most common species at both sites are the same.

Rooiels Cave

MNI from Sq. B2.

layers	3	4	5	6	7	8	9	10	11	12a	12b	13	14	15	16	17	18a	18b	19	20	21	22	23	Total
hottentot *Pachymetopon blochii*	23	6	3	1	2	3	9	22	6	15	6	19	8	3	1	3	12	2	8	2	-	9	15	178
Black musselcracker *Cymatoceps nasutus*	5	-	-	-	1	1	1	11	-	2	1	2	2	-	-	-	-	1	3	1	-	2	1	34
galjoen *Coracinus capensis*	1	3	-	-	-	-	1	5	-	3	-	4	-	-	-	-	-	-	-	-	2	-	2	21
dassie *Diplodus sargus*	1	-	-	-	-	3	-	1	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	6
white stumpnose *Rhabdosargus globiceps*	-	1	1	1	-	1	2	1	2	4	2	-	1	-	-	-	-	-	-	-	1	-	-	17
carpenter *argyrozona argyrozona*	1	-	-	1	-	-	1	2	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	6
flathead mullet *Mugil cephalus*	-	-	-	-	-		-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	1
klipfish *Clinnidae*	-	-	-	-	-	1	-	1	1	2	-	-	-	-	-	-	-	-	-	-	-	-	-	5
red steenbras *Petrus rupestrus*	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	1
white steenbras *Lithognathus lithognathus*	-	-	-	-	1	-	1	1	-	-	-	-	-	-	-	-	1	-	-	-	-	-	1	5
Total identified on jaw bones	31	10	4	3	4	9	15	44	9	28	9	25	13	3	1	3	13	3	11	3	3	11	19	274
Total identified on cranial bones	42	14	4	8	5	6	12	42	13	31	16	44	36	5	11	7	3	6	12	7	9	45	40	418

Table 7:2. A revised table of identfied fish species from Rooiels Cave. Excluding layers one and two and the Brown Layer as reported on by Smith 1981.

This may be due to the existence of similar marine habitats on the eastern and the western shore of False Bay. It may also suggest that similar procurement strategies were employed by the inhabitants. Line fishing is the most common method for catching hottentot and black musselcracker nowadays. The low numbers of *Mugil* at RC and the complete absence of *Mugil* at SWBC suggests that the estuary at Rooiels was not used as a fishing habitat, and the method of fish trapping with fish weirs was not practised at SWBC. In terms of the vertebrae counts, except for layers one and two, all layers in SWBC show a deficit of vertebrae whilst at RC only in the lower layers from 16 and 18 through to 21 a deficit of vertebrae have been recorded.

Although the fish assemblages from the two sites are very similar in the range of taxa present, it would seem that the strategies of processing fish in the sites were different. The low number of vertebrae present in SWBC may reflect the processing of fish at the site to be taken elsewhere (Table 7:3). RC is about two kilometres from the coast and fish were probably prepared at the shore and the trunk region of some fishes with vertebrae taken to the site without heads, hence the overwhelming numbers of vertebrae present in the site (Table 7:4). The surplus of 4740 vertebrae at RC represents 182 fishes not represented on cranial elements, whereas at SWBC cranial elements are over-represented and show a shortfall of 2501 vertebrae or 96 fishes. The predominance of cranial elements may suggest that many, but not all, of the fish heads were detached and the bodies, represented by vertebrae were either removed elsewhere or processed in such a way that not many of the vertebrae survived. If the fish was removed from the site and taken elswhere, then this behaviour would suggest that SWBC was a fish processing site and only used seasonally for fishing.

The black musselcracker is particularly prevalent in the two fish assemblages analysed but is absent from the daily records for False Bay catches. This specie is solitary and occurs on deep and shallow rocky reefs that have crevices and caves and they are nowhere abundant on the South African coast (Smith 1953; van der Elst 1988; Henshilwood 1995). The predominance of black musselcracker in the archaeological sites is unclear but may be related to a number of factors.

Smitswinkelbaai Cave

Fish vertebrae counts

Layer	MNI	vert.	Exp. Vert.	Deficit.	Surplus
1	11	359	338	0	21
2	35	934	910	0	24
3	84	2052	2730	722	0
4	81	1677	1898	775	0
5	16	462	520	142	0
6	53	1051	1690	641	0
7	20	160	338	178	0
8	26	452	546	6	0
9	11	149	208	37	0
Total	**337**	**7296**	**9178**	**2501**	**45**

Table 7:3. shows the surplus and deficit of fish vertebrae in the Smitswinkelbaai Cave (SWBC) sequence.

Rooiels Cave

MNI and Vertebrae counts

layers	MNI	Vert.	Exp.Vert.	deficit	surplus
3	42	1628	1192	-	436
4	10	612	260	-	352
5	4	184	104	-	80
6	8	334	208	-	126
7	5	266	130	-	136
8	9	502	234	-	268
9	15	823	390	-	433
10	44	1831	1144	-	677
11	13	575	338	-	237
12	31	1699	806	-	893
12b	16	354	316	-	38
13	44	1588	1144	-	444
14	36	1165	936	-	229
15	5	221	130	-	91
16	11	251	286	35	-
17	7	333	182	-	151
18a	13	184	338	154	-
18b	6	129	156	27	-
19	12	212	312	100	-
20	7	124	182	58	-
21	9	211	234	23	-
22	45	1215	1170	-	45
23	40	836	1040	204	
Total	433	15277	11232	511	4536

Table 7:4. Shows the surplus and deficit of fish vertebrae in the Rooiels Cave (RC) sequence.

First, the modern False Bay catches reflects mainly boat fishing and boats very seldom fish close inshore amongst the reefs where black musselcracker are more often found. Secondly the preponderance of black musselcracker in the archaeological samples may also be related to the timing of site occupation. Cooler climatic conditions have been recorded at Blombos Cave on the south coast ca. 6000 to 480 BP on shellfish (Henshilwood 1995), which suggest that SWBC, RC and Blombos Cave may have been occupied during the winter months.

The freemen on Robben Island were also given permission about the same time to catch and dry fish, provided that they sold them to the Company. The first advance beyond a purely local industry came when the Council of Seventeen in Holland gave instructions that the seine nets should be drawn regularly for catching harders. In 1658 four freemen T.C. Muller, J. Jansen, J. Elberts and G. Harmanssen went to Saldanha Bay, where they were permitted to settle and start the fishing industry (Thompson 1913). They became very successful and regularly supplied the fort in Cape Town, passing ships and other free burghers in the area.

After the construction of the outpost Oudepost 1 (hereafter OP1) at Saldanha, documentary sources confirm and describe the purpose of the post, which was to provision passing ships with water, vegetables and meat obtained from the local Khoikhoi herders (Böeseken 1961: 98-9). Fish was also supplied from OP1 to the company post at Mamre (Groen Kloof), and to local burghers. Other natural resources such as penguin and birds, eggs, train oil from seals, ostrich eggs and meat were exported to the settlement at the Cape. Fish were salted, packed in casks (Leibbrandt n.d. :1), and sent to the Cape, mainly as food for slaves, but also to supply the garrison (Leibbrandt 1902).

The drying of fish is still practised amongst the trek fishermen on the west coast today. Most often the southern mullet (harders) *Liza richardsoni* is used for drying and called 'bokkoms'. Sometimes other small sized fishes such as immature white steenbras, elf and white stumpnose are used for drying, but because they are deep bodied fish the sized fish of these species take longer to dry and spoil more easily than the harder fish which are much leaner. Several environmental factors influence the success of sun drying, including aridity, air temperature, and wind velocity. The most appropriate method of preparation is for the fish to be gutted, split longitudinally but not scaled. Thereafter the fish are submerged in a strong salt solution for two days, and then strung together in bunches and hung up or placed on wooden racks to dry. The unscaled fish has a better chance of preserving as blowflies are prevented from laying their eggs in the still humid flesh. The larvae of the blowflies are quite resistant to drying and sometimes the heat of sun drying does not penetrate deep enough to kill them, resulting in spoilage (A. Poggenpoel pers. comm.).

In 1673 the amount of fish needed for the slaves was about 4000 kg/month (Sleigh 1987). In general the demands were met by local fishermen called `Saldanhavaarders', who worked under contract to the company. Free Burghers such as Eksteen, also supplied fish to ships in Saldanha Bay (Leibbrandt n.d.: 641), and the men at the post were often expected to facilitate these operations. Occasionally the onus for this harvesting fell on the post. Demands were made directly to the post for fish in 1684 when the contract between the free trader van Dieden and the company ended, and Hans Jurgen Cling, the Post holder at Saldanha Bay, was instructed to provide fish to feed the slaves (Böeseken 1961). Again, in 1717 the free burgher contract was not renewed and a monthly quota was set for the Post, as for the one at Fish Hoek (Sleigh 1987). From its inception the Cape settlement relied heavily on fish and one of the main functions of the outposts was to supply the settlement with local provisions. The fish remains analyzed from the excavations at OP1 and the Posthuys at Muizenberg reveal differences in the fish composition that is contrary to the information recorded in the historical records.

8.1: Oudepost 1 (OP1)

On the north-eastern shore of Kraalbay in the Langebaan Lagoon the historical site, Oudepost 1 (OP1), is situated at the foot of Konstablekop (Schrire 1984, 1987, 1995). The archaeological material excavated under the co-direction of Carmel Schrire and myself revealed that the site was occupied by the Dutch during the 17th and early 18th centuries. Three stone structures were found at the site. The first, an approximately semi-circular arrangement of stone 25 m x 17 m with parts of the walls standing as much as 1.3 m high and 1.8 m wide, was built mainly with beach boulders (Schrire 1987), (Figure 8:1). Although it was referred to as a kraal by the local people, after inspection we found that the north-east corner of the 'kraal' had an angular bastion. This led us to believe that it might well be part of the fort or battery erected by the Dutch in 1669. The second structure was located several metres to the north-west of the first. It is a rectangular building 21 m x 6 m, with a dividing wall near the westernmost end.

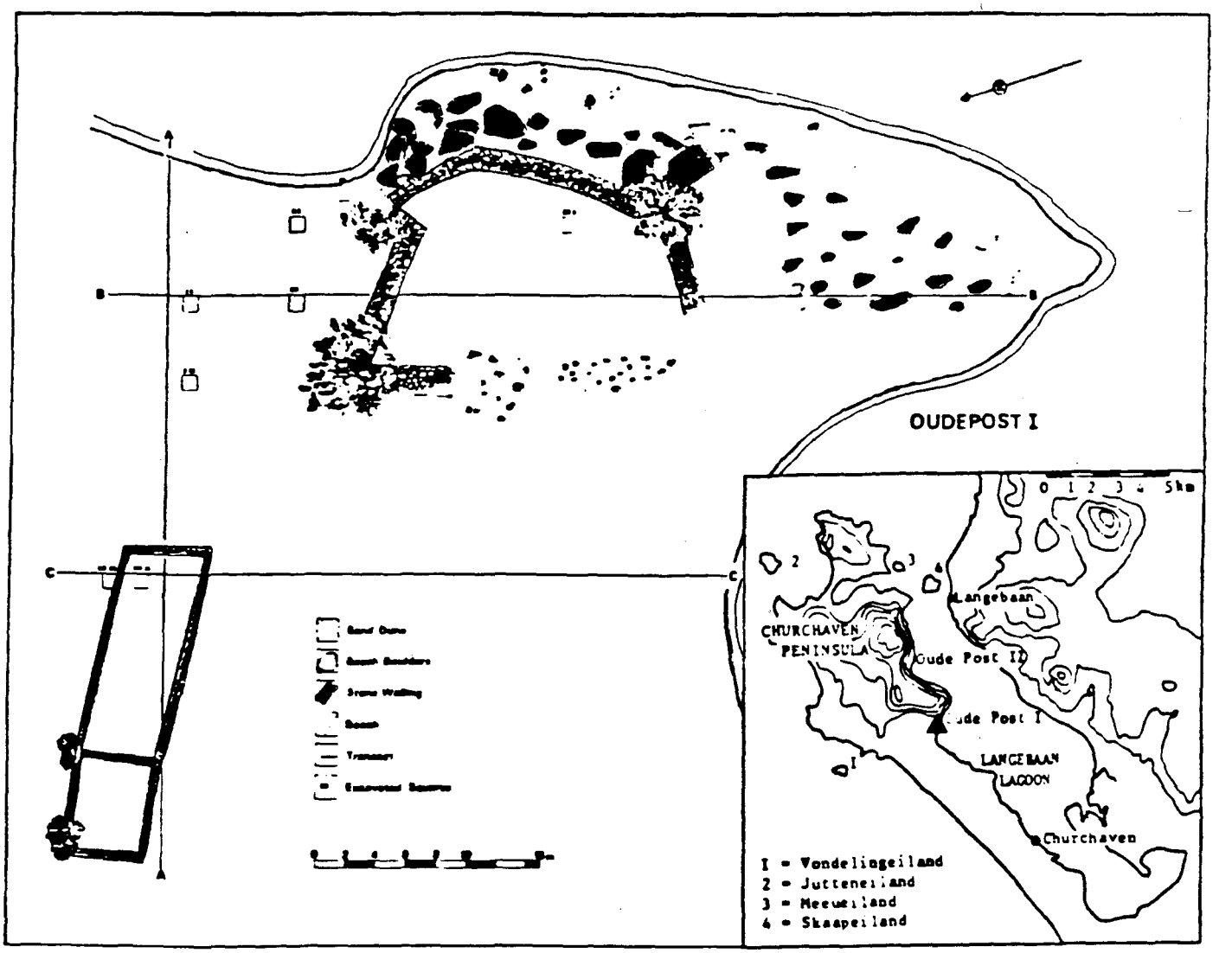

Figure 8:1. The location of the historic out post Oudepost 1 (OP1) on the Churchhaven Peninsula, south-western Cape.

The standing walls are slightly lower then those of one section of the fort and are only 54 cm wide. The third structure is a rectangular structure of uncertain significance (Schrire 1987; Schrire & Deacon 1989). The dietary and artefactual remains from the site as a whole suggest that occupation continued for a short period of time and fireplaces indicate that it may well be the Company Lodge as recorded in documentary sources. The faunal remains recovered from the site point towards a diet which was dominated by wild and not domestic animals, supplemented by birds, reptiles and fish (Cruz-Uribe & Schrire 1991). This preponderance of wild over domestic animals contradicts the documentary impression that most of the Post's diet was mutton and beef. The rich sample of bird remains, under analysis by G. Avery of the South African Museum, reveal the presence of at least forty species including game birds and waders.

8.1:1: Fish assemblage

The identification of 20 taxa was achieved according to characteristic body parts, with the MNI established using different parts for different species. White stumpnose *Rhadosargus globiceps* and white steenbras *Lithognathus lithognathus* were counted on maxillae, southern mullet *Liza richardsoni* on atlas and basi-occipitals, kob *Argyrosomus hololepidotus* and sea catfish *Arius feliceps* on otoliths, sharks on teeth and rays on serrated spines. In the case of sharks and rays teeth and serrated spines were used to indicate absence or presence per unit but not MNIs. The counts were then calculated for vertical and horizontal excavated units of various sizes, using the site sequence analysis in Schrire *et al.* (1990), (Table 8:1).

The most common species in the sample is the white stumpnose *Rhabdosargus globiceps*, which constitutes over 60% of the sample. This is followed by the southern mullet (harders) *Liza richardsoni* at 21%, and three other species, the white steenbras *Lithognathus lithognathus*, the kob *Argyrosomus hololepidotus* and the sea catfish *Arius feliceps* which together constitute 13% of the sample. The remainder of the sample is made up of sharks and rays which have been identified by the presence or absence of teeth and serrated spines in different stratigraphic layers and which may not, thus, be a true reflection of their numbers at the site.

Oudepost 1 (OP1)

Unit Species	FTII	LRII	LFII	LXII	LXEII	LRI	LFI	LXI	LXEI	FTI	FTX	II	I	X	TOTAL
white stumpnose *Rhabdosargus globiceps*	21	61	372	119	190	38	90	63	112	145	23	704	413	24	2375
southern mullet *Liza richardsoni*	6	11	102	45	122	9	8	13	47	26	4	285	98	4	780
white steenbras *Lithognathus lithognathus*	3	3	52	9	39	11	11	7	15	8	3	102	45	3	311
kob *Argyrosomus hololepidotus*	3	1	38	1	2	5	8	2	1	10	1	14	19	1	111
sea catfish *Arius feliceps*	1	1	2	1	2	1	3	1	1	30	5	4	35	5	92
hottentot *Pachymetopon blochii*	0	0	0	0	1	0	1	0	0	1	3	1	1	1	9
steentjie *spondyliosoma emarginatum*	0	0	1	0	2	2	1	0	1	0	0	3	3	0	13
leervis *Hypacanthus amia*	0	0	2	0	3	0	1	0	1	0	0	4	2	0	13
elf *Pomatomus saltatrix*	1	1	4	2	7	0	3	1	1	1	0	12	4	0	37
bamboo fish *Sarpa salpa*	0	1	0	0	0	0	0	0	0	0	1	1	0	0	3
snoek *Thyrsites atun*	0	0	1	0	0	0	0	0	0	0	0	0	0	1	1
Sting Ray *Dasyatis sephen*	0	0	1	0	0	0	0	0	0	1	1	1	1	1	6
Shark	0	1	2	1	1	1	1	2	0	4	3	3	5	3	28
Total	35	85	577	178	370	67	127	89	179	226	44	1135.	626	43	3779

Table 8:1. The identification of fish taxa through the sequence of Oudepost 1 (OP1).

The size of white stumpnose, southern mullet and white steenbras in the sample from OP1 indicate that all the fish captured were mature (Figure 8:2). Mature fish are caught in the deeper part of the lagoon and the use of a boat would have resulted in such a harvest. The historic records indicate that a small boat and a raft was present at the Post, and used to ferry water and other supplies to ships (Leibbrandt n.d. 121). Direct archaeological evidence of fishing is limited to relatively few artefacts. A musket ball drilled through as if for use as a line sinker, a number of iron hooks and a single copper hook were recovered (Figure 8:3). The use of nets played a important role in fishing in Table Bay, which may suggest that such methods were employed at the Saldanha outpost as well. Very large shoals of southern mullet enter the lagoon during the incoming tide, and are easily caught by a mass trapping method, such as trekking with a net from the beach or using a gill net set out in the deeper part of the lagoon by boat. The overwhelming preponderance of white stumpnose at the site and the low incidence of southern mullet seem to favour line fishing. If, however, southern mullet was the species most commonly exported to the fort in Cape Town, then few would have been consumed on site by the inhabitants, which would result in a low MNI count for southern mullet in the fish assemblage. Similarly we may not have located all the debris at the site, since it seems that a large proportion of the waste may have been dumped in the sea. Such dumps were excavated (Schrire *et al.* 1993) along the shore line where large quantities of fauna and artefacts were recovered, suggesting that the sample so far excavated should be treated with caution when interpreting relative numbers of individuals in the faunal sample.

The composition of the fish fauna at the post is interesting. Although the dominant species in the archaeological sample from OP1 is the white stumpnose, 80% of the fish caught in the lagoon today are southern mullet (Pollock & Christie 1976). Interestingly, as explained earlier, the most common fish in the sample from the LSA site of Stofbergfontein is the southern mullet. The contrast in the relative frequencies of different species between the two neighbouring sites of Stofbergfontein and OP1 may relate to the technique of catching fish rather than availability of fish. At Stofbergfontein hunter-fisher-gatherers used a rock wall fish trapping technique whereas at OP1 the soldiers used nets or lines from boats.

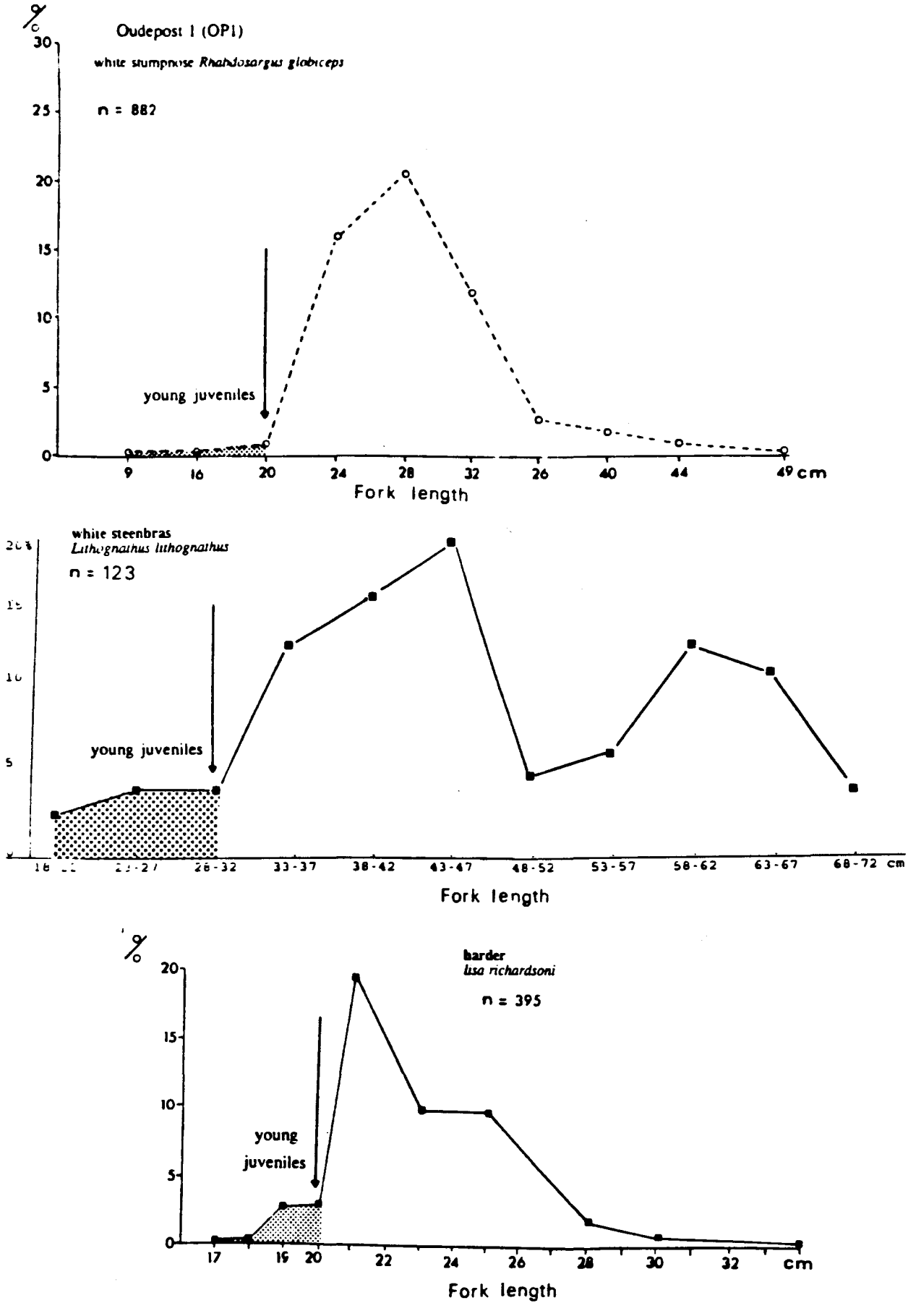

Figure 8:2. The size distribution of white stumpnose *Rhabdosargus globiceps*, white steenbras *Lithognathus lithognathus* and southern mullet *Liza richardsoni* from OP1, the mandible size show that most of the fish caught are adult.

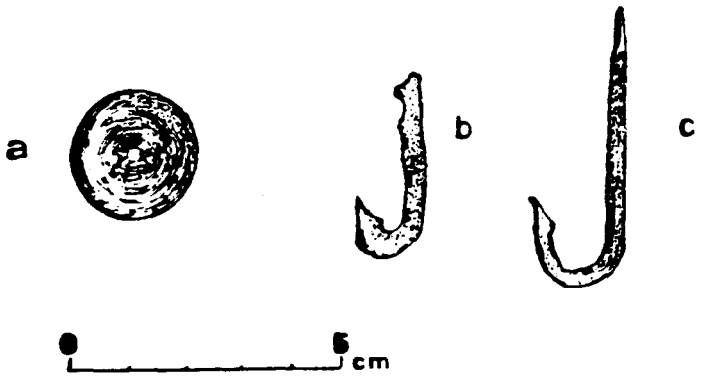

Figure 8:3. Fishing equipment from Oudepost 1. a) musket ball with hole drilled through the center. b) a fish hook made from iron and c) a copper fish hook.

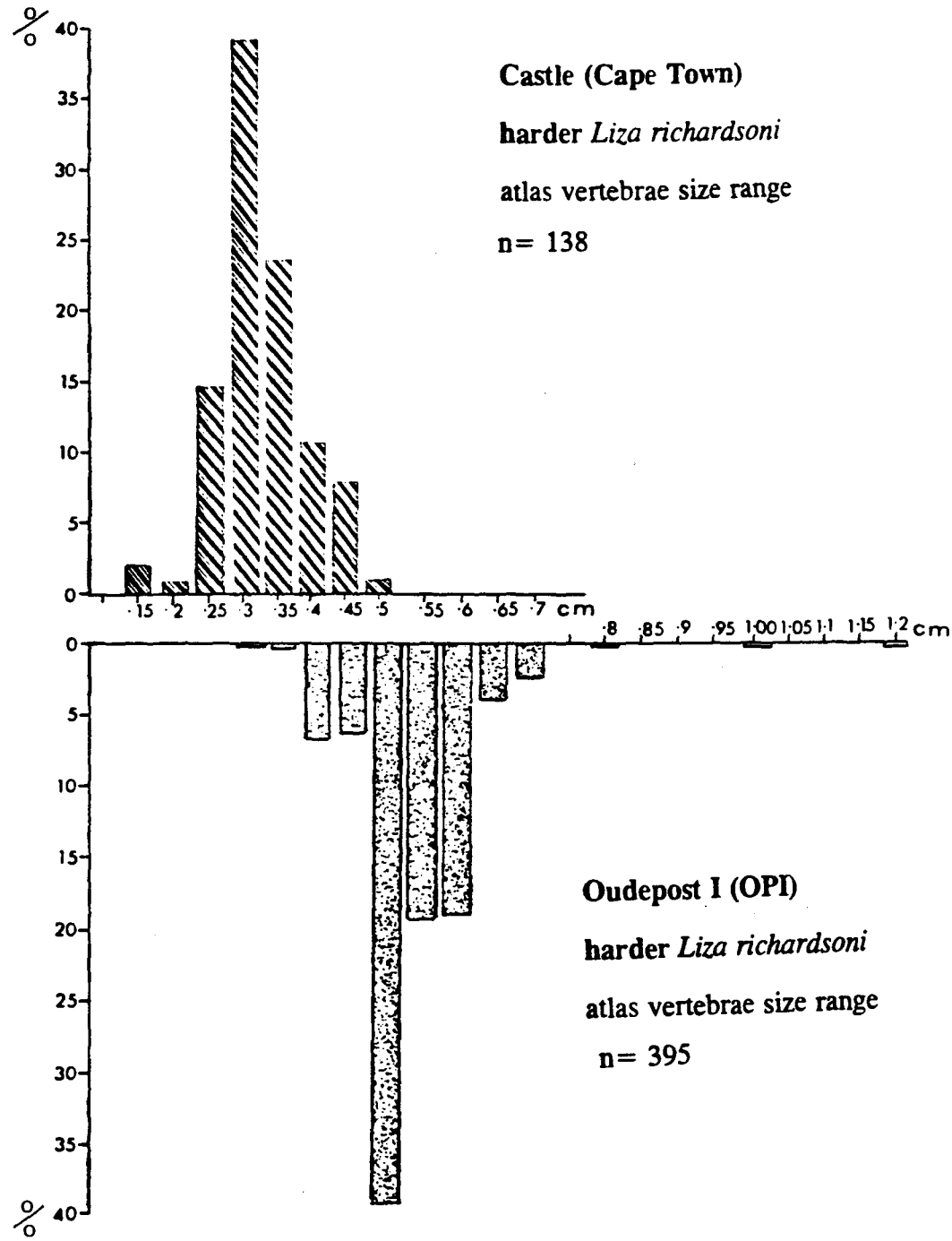

Figure 8:4. The size distribution of southern mullet *Liza richardsoni* atlas bones from the Castle in Cape Town and Oudepost I (OPI).

Of all the fish samples so far mentioned none has shown any butchering marks or other signs of procurement. Those from OP1 and the Castle are exceptions. Many of the atlas vertebrae and basi-occipitals found have been split through the middle, which suggests a method of filleting or in some cases the removal of heads (Figure 8:5). A number of supra-occipitals from OP1 have been cut through at an angle which suggest that the eye orbit and snout section of the skull have been removed. In some instances a haemal vertebral spine of some vertebrae have been cut off, a technique which is normally used on some of the larger fishes, such as snoek *Thyrsites atun*, to expose the thicker flesh for sun drying. Because none of the fish bones from the prehistoric sites have revealed any form of butchering, it is difficult to say whether or not this kind of processing was practised in prehistoric times.

8.3: Posthuys

The site of the Posthuys is situated below the Muizenberg Mountain on the western shore of False Bay coast on the Cape Peninsula (18° 15'S, 30° 10'E) (Figure 7:1). The Posthuys was built in 1673 as one of a number of signal stations to relay information to the Castle when passing ships were sighted entering False Bay. The site is known as one of the oldest Dutch buildings on the Cape Peninsula with more than 300 years of continuous occupation. The building comprises a single storey, white, thatched stone structure of three small rooms, and an open stoep overlooking False Bay. Considerable building additions have been made to the original dwelling over the last 70 years, in the process causing major soil disturbances (Saitowitz 1982).

Archaeological investigations were first undertaken by Mr H.J. Vos in 1979 (unpublished observations) and later by Saitowitz and myself in 1981 (Saitowitz 1982). The aims of the archaeological programme were to sample the cultural and faunal material and to attempt reconstruction of certain aspects of the economy and diet of frontier life during the Dutch settlement at the Cape. The excavations conducted by Vos removed all of the deposits inside the structure, and some parts of the deposit located along the south wall. The excavations conducted by Saitowitz and myself concentrated on two areas around the outside of the buildings.

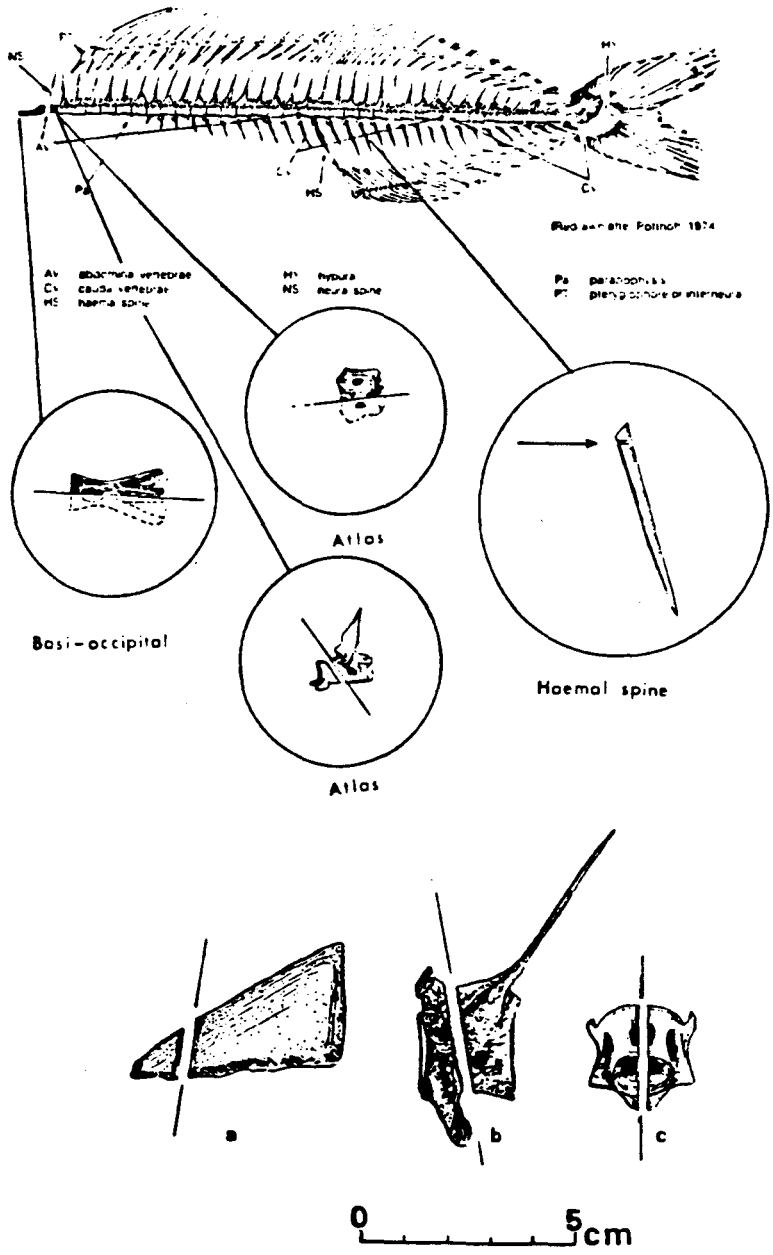

Figure 8:5. Shows cut marks on differnt bones from the Castle and OP1. Numbers one to three are basi-occipital and atlas bones that has been split longitudanally and four is a heamal spine that has been cut. a) is a supra-occipital bone with the front part removed, b is a abdominal vertebra which have been cut through the middle and c is a atlas vertebra that has been cut longitudanally from OP1.

During the course of this later work, the label SW was used to refer to the excavations near the south wall. The SW Posthuys excavation was fairly small but revealed an early, probably precolonial midden deposit truncated by the foundation walls I and II of the building. Banked around these walls is later midden which consists mostly of infill and contains 18th and 19th century material mixed with shell. The deposits were divided into a number of stratigraphic layers, of which the uppermost were clearly mixed and consisted of material used to create the garden terraces, probably in the late 19th and early 20th century. Below this a grey soil contained material also of a mixed nature, in this case representing 18th and 19th century debris. At the base of the sequence is a brown sand that is part of the original land surface on which the Posthuys was built and that contains some prehistoric material.

The NW Posthuys excavation was much larger, 52 m^2 as compared to 6 m^2, but revealed no connection between the walls and the middens containing fauna and artefacts. No precolonial material came from this excavation. Underneath the surface material with broken daga, mortar and plaster and some road metal (Saitowitz 1982) were deposits probably 19th or 20th century in age, with small amounts of fauna. More significantly, below this was a dark brown soil with large numbers of ceramic fragments, mainly decorated earthenware as well as some glass and nails. This material is clearly roughly contemporary with that from the Castle and OP1. A brown sand with clay at the base of the sequence had large amounts of fauna as well as ceramic and glass fragments that again appear to be approximately contemporary with the Castle and OP1.

8.3:1: Fish assemblage

Fish bone recovered from the 3 mm sieves at the Posthuys were sorted by body part in the archaeology laboratory at the University of Cape Town. From this exercise it was evident that the most common cranial bones available for species identification were premaxillaries and dentaries. The species frequencies given in Table 8:3 have been derived from these bones, whereas all body parts were counted from all units that contained fish bone at the site (Table 8:3).

Posthuys (Muizenberg)

Identification of fish taxa

STRATIGRAPHIC LAYERS	Sur.	SpI	SpII	SpIII	SPIV	BSBC	GS	LIII	BS	RS	TOT
white stumpnose *Rhabdosargus globiceps*	4	3	2	2	1	2	3	1	0	0	18
black musselcracker *Cymatoceps nasutus*	2	3	3	2	1	0	1	1	0	0	13
white steenbras *Lithognathus lithognathus*	2	3	2	1	1	0	0	0	0	1	10
cape kob *Argyrosomus hololepidotus*	2	2	1	1	0	1	1	1	0	0	9
snoek *Thyrsites atun*	1	0	0	2	1	1	1	1	0	0	6
sea cat fish *Arius feliceps*	1	1	1	0	0	1	1	0	0	0	5
red steenbras *Petrus rupestrus*	3	0	1	0	0	0	0	0	0	0	4
carpenter *Argyrozona argyrozona*	1	1	0	0	0	0	1	0	0	0	3
harder *liza richardsoni*	0	0	2	1	0	0	0	0	0	0	3
shark	1	0	0	0	1	0	1	0	0	0	3
red stumpnose Chrysoblephus laticeps	1	0	0	1	0	0	0	0	0	0	2
hottentot *Pachymetopon blochii*	0	0	0	2	0	0	0	0	0	0	2
klipfish *Clinnidae*	0	0	0	2	0	0	0	0	0	0	2
elf *Pomatomus saltatrix*	0	0	1	0	0	0	0	0	1	0	2
unidentified sp. no 1.	0	0	2	0	0	0	0	0	0	0	2
unidentified sp. no 2.	0	0	1	0	0	0	0	0	0	0	1
Total.MNI	18	13	16	14	5	5	9	3	1	1	85

Table 8:3. The distribution of fish taxa through the sequence of the Posthuys, Muizenberg.

All fish from units which contained obviously late artefactual material, specifically late 19th and early 20th century in age, were excluded from further analysis. Similarly, the material from the precolonial units was kept separate. A total of 85 fish from 14 species have been identified from the 18th and early 19th century layers, using various bodyparts, principally premaxillaries and dentaries. The most common species represented in the sample is the white stumpnose *Rhabdosargus globiceps* with a MNI of 18. The fish fauna from Posthuys reflect a sample taken from different fishing habitats that required different techniques to make the catch. The presence of snoek *Thyrsites atun*, suggests fishing with a boat and hand lines in water no less than 5 fathoms. Anglers taking snoek from deep rocky points have been recorded in the past, but these are very rare indeed (Biden 1954). No snoek bones have been recovered from prehistoric fish samples excavated around False Bay at sites such as Gordons Bay midden (van Noten 1967, 1974), SWBC (Poggenpoel & Robertshaw 1981) and RC (Smith 1981), or at Bonteberg shelter on the Cape Peninsula (Maggs & Speed 1966), although many thousands of snoek must have been present in False Bay during the optimum fishing season. Boats were almost certainly not used by the local people for marine fishing before the arrival of Europeans at the Cape, hence the absence of snoek in the prehistoric samples. The low numbers of southern mullet *Liza richardsoni* in the sample may indicate that such mullet as were caught were exported to the Castle in Cape Town but, on the other hand, it may reflect the non use of a mass trapping method such as a net or fish trap. Some of the other species in the sample could easily have been caught from the nearby rocks with hand lines and rods, although they may as easily have come from boat fishing or have been collected by the locals from the fish-trap near St James (Avery 1975).

8.4: Conclusion

To reconstruct life and behaviour patterns that existed during the colonial period, historians have depended very heavily upon evidence provided by the written records relating to the activities of the colonists that occupied the Cape. Although historians, with the help of the records, have succeeded in tracing the evolution of technology and establishing the

fundamental trends of economic life, they may not at all times have recorded the activities that related to economic trading operations as set out in their daily journals. In most of the early records reference is made to the outposts supplying the colony in Cape Town with fish and local provisions (Leibbrandt 1902; Böeseken 1961; Sleigh 1987). The analysis of fish assemblages from the historical sites examined in this thesis suggest that direct application of written records to archaeological interpretation should be more carefully approached. As pointed out previously, the size of southern mullet found in the Castle does not correspond with those found at OP1. As southern mullet are more commonly used for drying, it was assumed that the low incidence of southern mullet at OP1 is related to the export of southern mullet to the Castle. But since the size of the southern mullet in the Castle is much smaller then those caught at OP1, I would suggest that very few or no southern mullet were exported to the Castle from OP1 and that the bones of those recovered from the excavations at the Castle came from the shores and local estuaries in the vicinity of Table Bay. Similarly the warm water species present in the Posthuys assemblage are absent from the contemporary fish assemblage at the Castle and are only found in the later assemblages excavated. The species in question red roman *Chrysoblephus laticeps*, red steenbras *Petrus rupestrus* and red stumpnose *Chrysoblephus gibbiceps* are regarded as high quality fish and would have been served only at the main table of the Governor. The absence of these species from the contempary fish assemblage at the Castle points to very little, if any, fish being exported to the Castle from the Posthyus at Muizenberg.

The introduction of different fishing techniques such as boats and nets during the colonial period allowed for the exploitation of species which were not exploited earlier by the hunter-fisher-gatherers. At the same time, a number of similarities can be seen in the fish composition between OPI and the Posthuys. The dominant species in both sites is the white stumpnose. Both sites have fish that can only be taken in deep-water with the use of a boat (snoek and tunny are present in both samples) and the number of southern mullet consumed on site is low in both cases.

A number of inferences may be drawn from the results. First, although the type of species found at a site is related to its environmental placement, the method of procurement also plays an important role. The contrast

between the fish samples from OP1 and Stofbergfontein may be related to the fishing method employed, since it seems unlikely that this difference is due to changes in availability of fish in the lagoon over the past 1200 years. Likewise the hottentot and black musselcracker at RC and SWBC on the False Bay shore reflect the rocky environment in the False Bay area. At the same time a site like the Castle on Table Bay, does not necessarily dictate the composition of fish taxa found in historic sites, since fish may have] been imported from several different fishing habitats, i.e. False Bay, Langebaan Lagoon and the open waters from Saldanha to Cape Town, including estuaries in Table Bay.

CHAPTER NINE

PRE-COLONIAL FISHING TECHNIQUES

Although there are many tens of thousands of Early and Middle Stone Age sites scattered across the southern African landscape (Sampson 1985), very few of them have associated faunal assemblages. There is a small but increasing sample of coastal MSA sites in South Africa which have produced faunal assemblages that might be expected to include fish bone from marine species. Best known among these are the Klasies River Mouth sites on the Tsitsikamma coast (Singer & Wymer 1982; Deacon & Shuurman 1992; Klein & Cruz-Uribe in press.) and Die Kelders near Hermanus (Schweitzer 1974; Grine *et al.* 1991; Avery *et al.* 1995; Klein & Cruz-Uribe in press), but sites such as Blombos Cave on the southern Cape coast (Henshilwood 1995), Sea Harvest (Volman 1984; Grine and Klein 1993), Hoedjiespunt near Saldanha Bay (Berger & Parkington 1996; Parkington in prep.; Parkington & Poggenpoel in prep.) and Boegoeberg near the mouth of the Orange river (Parkington *et al.* in prep) add more samples to the list. The faunal remains from this suite of sites suggest that the exploitation of aquatic resources such as seals, penguins and shellfish was not restricted to the Holocene, but that it was already part of the economic base of coastal hunter-gatherers during the last interglacial (Bailey & Parkington 1988). Apart from a few otoliths at Klasies River Mouth, which might well have been brought to the site in the stomachs of seals, there is virtually no evidence of fish in these MSA last interglacial sites.

Not surprisingly under these circumstances, the evidence for fishing equipment in MSA sites is non-existent. The absence of evidence for fishing, as well as that for the catching of flying birds, is taken by Klein & Cruz-Uribe (1984) as a reflection of significant technological differences

between the MSA and LSA coastal hunter-gatherers of the southern African coastline. It is also often assumed that during the MSA scavenging played an important role in the obtaining of protein, since many of the large mammals are mainly represented by skull and foot elements in the deposits (Binford 1984; Klein & Cruz-Uribe 1987; Klein & Cruz-Uribe in press). The few associated fish remains may have entered the deposits through being eaten by birds roosting in the cliff face rather than through fishing (Deacon & Schuurman 1992).

This apparent lack of interest in fish procurement among MSA coastal people is all the more significant given the kinds of coastal environments suggested by the geological and palaeontological evidence. According to geomorphological evidence gathered by Tankard (1975, 1976), Butzer *et al.* (1978), Hendey & Volman (1986) and Miller (1987), during the Last Interglacial between about 130 000 and 70 000 years ago, the sea level reached about 7 m above present sea level on the Cape west coast and between 5 m and 12 m above present sea level on the south coast of South Africa. This rise in sea level would have placed the coast line about 100 m inland from the modern coast line creating sheltered lagoons south of EBC in the area near Die Brak (Miller 1987). This evidence for a higher sea level stand is also supported by the presence of *Solen capensis* in the basal layers of the Cape Deseada gypsum deposits (Tankard 1976: Miller 1987). Such embayments would have provided ideal conditions for fishing, but were apparently not utilised in that way, in stark contrast to the Holocene in similar circumstances. After about 120 000 BP sea level started to retreat creating conditions for calcretes, ferricretes and pebbly conglomerates to form around the edges of the Verlorenvlei (Netterberg 1979; Miller 1987).

The number of sites reliably dated to the middle of the Last Glaciation is extremely small, making it difficult to chart the transition from MSA to LSA, which probably happened at that time. The sparseness of later MSA and early LSA sites may be related to the extreme aridity proposed by some researchers for this time interval (Deacon 1983; Deacon & Lancaster 1984; Deacon *et al.* 1984; Klein & Cruz-Uribe in press), that regionally depressed both animal and human populations, but must surely be partly explained by the inundation of sites by the rising terminal Pleistocene sea levels.

After the maximum regression to more than 120 m below present sea level at about 18 000 years ago, the landscape saw some drastic environmental changes as transgressive water movements pushed the coastline further east. With no outstanding features, the approach of the sea was fairly rapid. The available bathymetric records and seismic observations (Birch *et al.* 1991) show that no prominent features or contours interrupt the shore profile off the Elands Bay coast, but, because of differences in the local topography and rates of ice melting, the pulses of transgression varied between 18 000 and 8000 years BP. At 11 000 years ago at EBC and NBC the first fish bone appears, though we can be sure that this is not evidence for the earliest fishing. The evidence for this beginning lies below the sea.

9.1: Fish gorges

The earliest presumed method of fishing in the south-western Cape is recorded at three sites, NBC (Klein 1972a; Inskeep 1978, 1987) Byneskranskop (Schweitzer & Wilson 1982) and EBC (Parkington 1976a). We believe fish were caught with small slivers of bone, smoothed and sharpened at both ends. These have been called 'fish gorges' and since they have been only found in association with coastal middens that contain fish bone, the gorges have been assumed to be part of the fishing equipment used by the inhabitants of these sites, but could just as easily have been used for catching birds (Figure 9:1). The mean size of the gorges found at NBC is much larger (mean size 38 mm), than those from EBC (mean size 27 - 28 mm), (Deacon 1984; Parkington 1976a). At EBC more then 90% of the gorges were found in package thirteen, which has been dated to 9600 ± 90 BP (Pta. 686), (Parkington 1976a; Parkington in prep.). The interesting observation here is that the fish gorges are only associated with deposits dated from 10 000 to 8500 BP at all three sites.
At Byneskranskop a total of eight fish gorges were discovered in deposits dated to this period. It has been noted that only a few fish were associated with the gorges (Schweitzer & Wilson 1982). Whether or not these gorges are actually fishing implements is debatable.

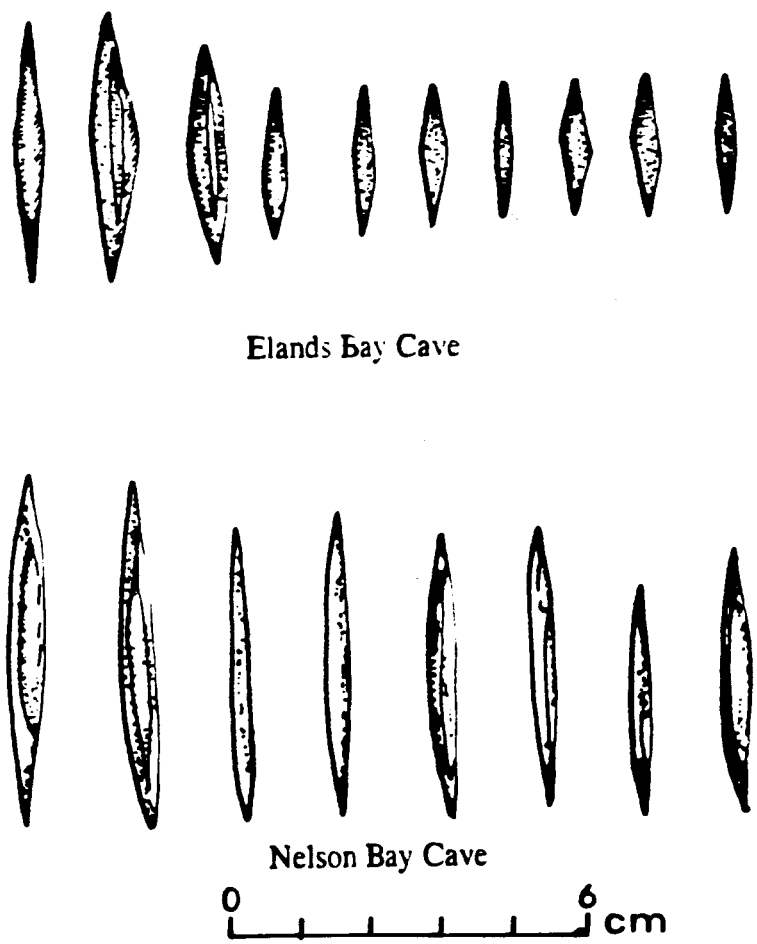

Figure 9:1. Fish gorges recovered from Package 13 at Elands Bay Cave and the lower deposits of Nelson Bay Cave.

At NBC the gorges are associated with rather large fish whereas at EBC the gorges are found in association with small sized fish compared with those in layers which lack fish gorges.

Likewise at Byneskranskop the gorges appears only in layers with very few fish. The discrepancy between the size of gorges and the size of fish caught at EBC and NBC might be explained in terms of the utilization of different fishing habitats. At Elands Bay the Verlorenvlei estuary is within walking distance of the cave. If the estuary was used as a fishing habitat during the time when the deposits with the gorges accumulated, then it is plausible that the small sized gorges would be needed for catching the juvenile fish in the estuary. At NBC there is no estuary within close proximity of the site and fishing probably took place along the coast. Since most estuarine species leave the confines of the estuary after sexual maturity, those that are found in marine environments are naturally larger.

Part of the problem here is that technological and environmental changes seems to be contemporary and perhaps interdependent at the end of the Pleistocene making the separation of these phenomena difficult to assess. At EBC, the real difference between fish samples associated with gorges and those without, is the size of the fish caught. Small white steenbras are associated with gorges which may indicate that whilst fish gorges were used the coast may still have been some distance away and that estuarine fishing may have been more profitable in relation to coastal fishing than subsequently.

Although most of the archaeological evidence suggests that the fish gorge technique was discontinued after 7000 years BP, one such double pointed bone artefact was recovered from a LSA deposit at SWBC on the Cape Peninsula, which has been dated as not older than 1420 $\pm$ 35 BP (Pta 2198) (Poggenpoel & Robertshaw 1981). Goodwin (1946) also reported that a Mr Pike informed him of a fisherman who found a fishing rig stuck in a crevice between two boulders on a beach. The fishing line was made of a wild vine of fibrous texture with a hook made from bone tied in the middle with sharpened ends. The description of the hook is very similar to the double pointed bones described as fish gorges from the archaeological sites. This evidence would suggest that although fish gorges made from bone are not common in later deposits occasionally they are found and that in some cases a more friable material such as wood or thorn may have

been used that did not survive in the archaeological record (von Brandt 1984). Ethnographically the making of gorges from *acacia* thorn by coastal fishermen to use as fish hooks was recorded by Maclaren (1958) in Mozambique.

9.2: Line sinkers

If gorges went out of favour then the fishing method that replaced the fish gorge technique is not fully understood. A possible fishing technique that appears in the sequence at NBC is in the form of small rounded pieces of indurated shale that have tie grooves ringing them. These, it has been speculated, may have been used as line sinkers or net weights (Figure 9:2) (Deacon 1984; Inskeep 1987). The size and weights of the grooved stones suggests that they may well have been used as line sinkers (weights between 4 and 20 g), rather than net weights. Examples have been found at many sites on the south-east coast of South Africa (Louw 1960; Deacon 1970; Van Noten 1967, 1974; Inskeep 1987), but none have appeared in sites along the west coast thus far. The sites that have produced sinkers, have revealed no artefact that could have been used as a hook, suggesting that whatever type of implement was used either did not survive in the archaeological record or we have not been able to identify it as a fish hook. It would seem that the earliest date for sinkers comes from the site near Matjes River which is some twenty kilometres east of NBC. Louw (1960) reported that there are fourteen shale beads from layer C which is dated to between 7700 and 5400 BP; these could have been misinterpreted and may in fact be line sinkers. At NBC the sinkers appear between levels 78 and 64 which are dated to 4250 $\pm$ 60 BP (Pta 2916) and 3350 $\pm$ 50 BP (Pta 2910) respectively, which indicate that the line sinkers appear later at NBC than at Matjes River rock shelter. At Swartdrif midden near the Storms River Mouth excavated by Deacon (1970), two shale grooved stones were found associated with shellfish and fish remains. Although the site was not dated, no pottery was associated with the grooved stones. Likewise grooved stones disappeared shortly after 3350 BP at NBC, suggesting that grooved stones may relate to the period before the introduction of pottery along the south-east coast of South Africa (Inskeep 1978).

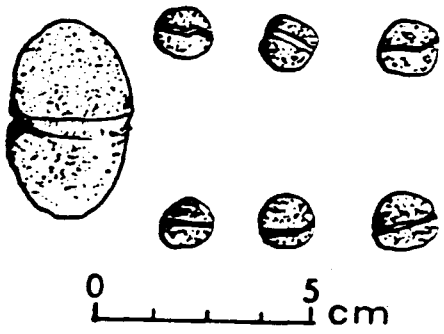

Figure 9:2. Line sinkers from Nelson Bay Cave (after Deacon 1984; Inskeep 1987).

9.3: Fish hooks

In the Natal region a number of sites have yielded fish hooks. They are single shouldered hooks 3 to 4 cm in length, made from bone with a small hook end (Figure 9:3). The hooks are associated with LSA deposits dated between 4500 and 2100 years BP (Maggs & Ward 1980; Mazel 1986, 1988). These hooks are also associated with small mini points (13 - 19 mm in length) which may be part of the fishing equipment. The distribution of these hooks is interesting since a number of sites in Lesotho and the Transkei have yielded similar shaped hooks (Cable *et al.* 1980). The hooks seem to be associated with riverine sites, since none have been discovered in marine coastal middens. It would also seem that the type of hook made for fishing is also a local phenomenon since none have been found further west in the eastern Cape. A number of inland sites have been excavated by Hall (1990) in the eastern Cape, with large amounts of freshwater fish and no fish hooks similar to those discovered in the Transkei, Natal or Lesotho regions. Similarly the many excavations conducted by Deacon and Binneman along the eastern Cape coast yielded no fish hooks whatsoever (Deacon 1970; Hall 1990; Binneman in prep.). This would imply that the fish hooks associated with the LSA deposits are first only found associated with riverine fishing sites and secondly have a local distribution that includes Natal, southern Lesotho and the Transkei.

9.4: Basket or net fishing

Although net fishing has not been recorded historically for the indigenous inhabitants of the Cape, fishing with basket traps has been documented (Alexander 1838). The use of nets has been recorded in rock paintings in association with driving and trapping game animals (Manhire *et al.* 1985) (Figure 9:4). At a number of inland sites in the western Cape, i.e. De Hangen, Diepkloof (Parkington & Poggenpoel 1971, 1987), Renbaan (Kaplan 1984), Klipfonteinrand II (Nackerdien 1989),

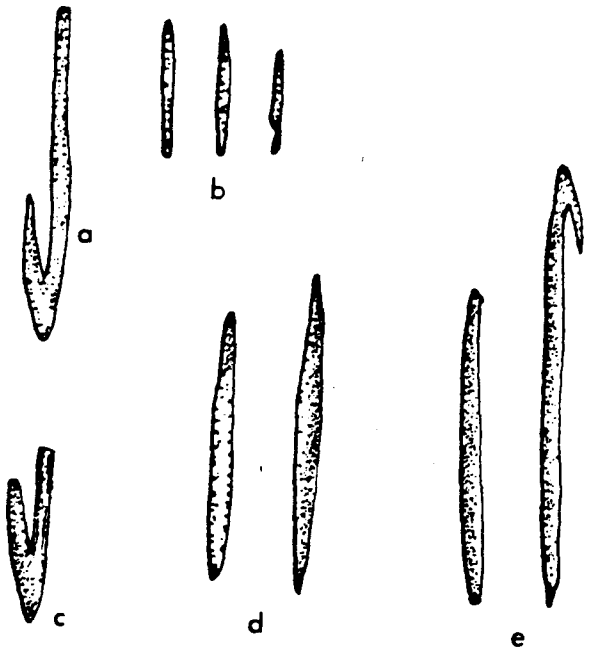

Figure 9:3. Fish hooks and mini points from Kwa-Zulu Natal. a) fish hook with hookend, b) small mini points (after Mazel 1986). c) and d) broken fish hooks from Nkupe shelter (after Mazel 1988) and e) fish hooks from Driel shelter (after Maggs & Ward 1980).

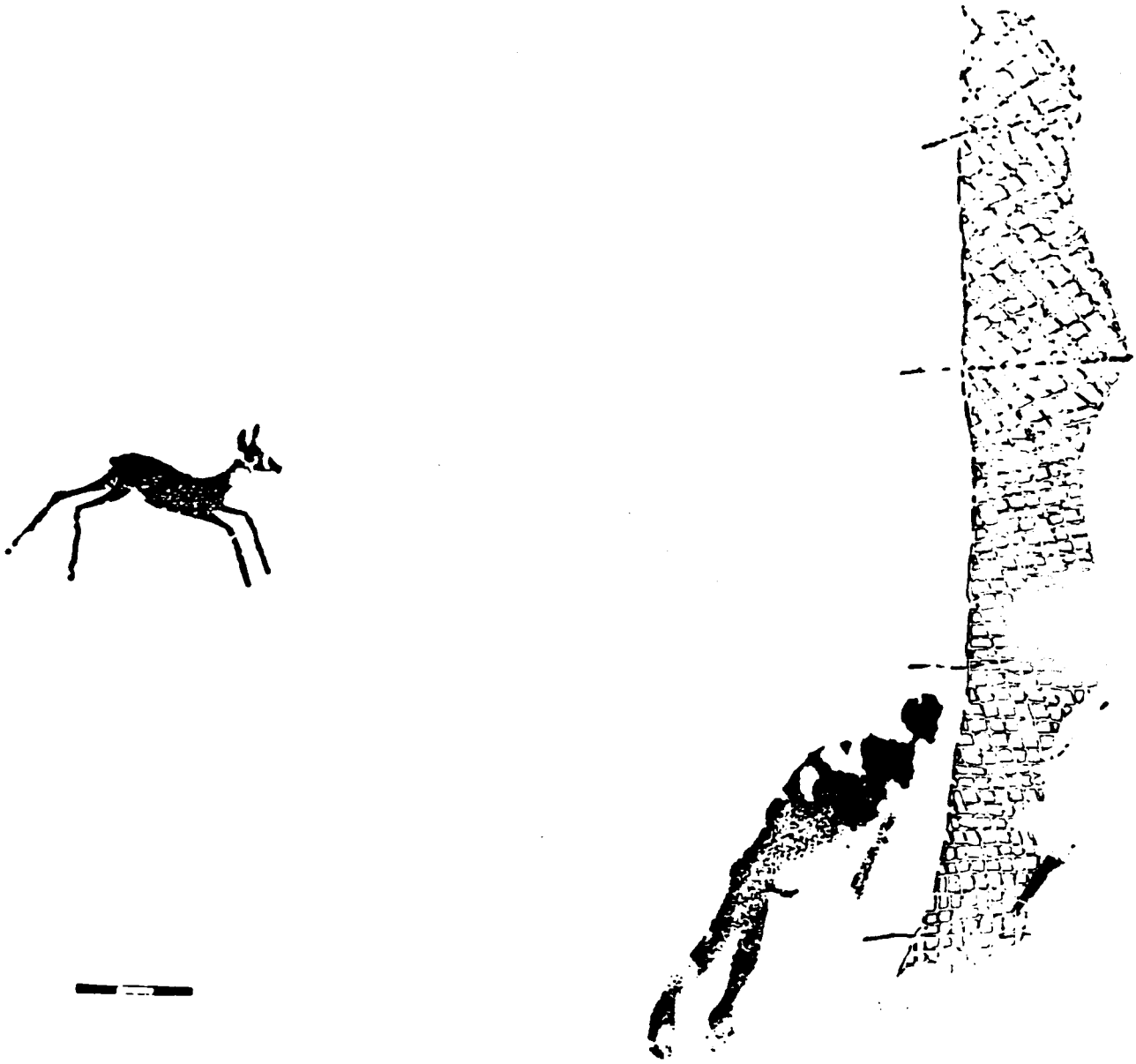

Figure 9:4. A hunting scene with a net from Boontjieskloof in the Cederberg. (after Manhire *et al.* 1985).

Andriesgrond (Anderson 1991) and Faraoskop (Manhire 1993), some fragments of pierced reeds that could have been part of mats or baskets were recovered from the deposits. Among the Nama, of the northern Cape, ethnographic observations indicate that fish were caught with the use of a tunnel net (formerly constructed from the thin roots of trees like the *Acacia karroo*), as well as conical baskets made of stick grass (Alexander 1838). The baskets are placed in parts of the river just below rapids or in channels. The mats are used to form barriers in the deeper parts of the river. A number of people enter the river some distance higher up and walk towards the rapids, driving the fish in the direction of the baskets held by other men (Clark 1959). The fragments of pierced reeds found in the Cederberg sites may have been part of similar contraptions to catch fish in the Olifants River valley. The construction of nets was known to hunter-gatherers since some painted scenes of nets used as bags to carry ostrich eggshell water-bottles have been recorded (Paterson 1789). It therefore may have occurred to them that the nets could also be used for fishing. Some fragments of netting have been preserved in a cave near Bredarsdorp in the southern Cape (Grobbelaar & Goodwin 1952), Melkhoutboom in the eastern Cape, (Deacon 1969) and at Diepkloof Rock Shelter (Parkington & Poggenpoel 1987). (Figure 9:5)

9.5: Fish-traps

Fish-traps or stone weirs are widely distributed along the south and south-east coast of South Africa where some are still in use today (Avery 1975). These features are built out of stone, along the open shore, or in natural gullies and channels which are sometimes blocked off to create an enclosed area with walls high enough to allow fish to swim over only at high tide, and as the tide recedes the fish are trapped in the enclosure (Figure 9:6).

Clearly the construction and upkeep of these fish-traps demands a lot of manual labour. For this reason the walls are sometimes holed to help with the water drainage as the tide recedes. Other factors which help with the preservation are the angle of the walls to the off-shore surf break or cementation of the rocks (Avery 1975).

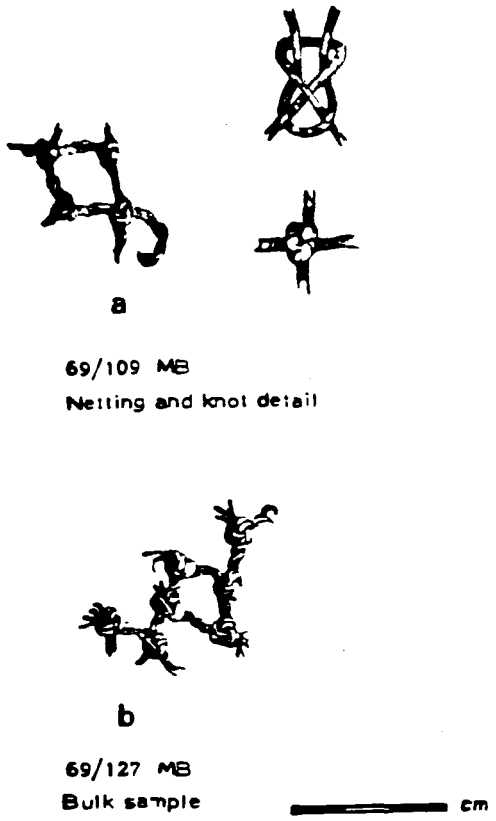

Figure 9:5. Fragments of nets excavated at Melkhoutboom Cave in the eastern Cape (a and b after Deacon 1969) and at Diepkloof Rock Shelter on the west coast near Elands bay in the south western Cape (c after Parkington & Poggenpoel 1987).

Figure 9:6. Fish-traps near Arniston on the south-east coast of South Africa (Photograph by courtesy of G. Avery).

The seaward side must be gently sloped to provide easy access to incoming fish feeding in the shallows when the tide is up. The effectiveness of fish-traps is influenced by a number of factors. Firstly fish-traps provide its best yields during high spring tides (during full moon), which means that groups using the fish-trap should be at the coast monitoring the traps during these periods. Catches are worst when there is a new moon. Secondly the prevailing wind plays an important role as they influences the surface waters. Offshore winds drive the surface water away from the shore and few fishes swim along the shore under these conditions, whereas onshore winds or calm weather increase the possibility of good catches. The white steenbras tend to shoal mostly along the sandy coast when the south-easterly wind blows. To lure the fish into the fish-traps ground bait is sometimes used. Other shoaling species such as southern mullet, elf, strepies and white stumpnose are caught in large numbers, but they are highly seasonal and catches fluctuate during the year. The maintenance and upkeep requires daily inspection of the walls which means that groups utilizing this method have to spend a large proportion of their time monitoring the traps. The construction of these weirs requires boulders of moveable size, which means that fish-traps tend to occur in rocky areas, gullies and along open stretches of beach where large boulders are available. The dating of these features is difficult. Goodwin (1946) proposed that the excavation of coastal middens in close proximity to fish-traps may reveal differences in the fish composition from sites in areas without fish-traps. Avery (1975) points out, however, that most of the middens with excavatable deposits do not occur in the same areas as the fish-traps which makes it difficult to associate midden and trap.

The alternative is to consider the height of sea level fluctuations and the effectiveness of traps along the coast. Most of the rock built fish-traps visible on the coast today are situated within the intertidal zone. Since fish-traps must be sensitive indicators of sea level, they could only have been functional at a time when sea level had reached its present mean some time after 3000 years ago (Avery 1975; Inskeep 1987). It is difficult, however, to establish if fish-traps were used before sea level reached its present mean, since some may lie inundated while others may have migrated towards the shore and ended up as part of storm beaches or have been moved piecemeal by the waves as water rose.

Geomorphological evidence indicates that between 6000 and 8000 BP the sea level was three metres higher than today, which means that all the fish-traps visible today would have been inundated (Tankard 1975; 1976 Cohen *et al.* 1992; Jerardino 1993; Miller *et al.* 1993). At 10 000 years ago the sea was more than 25 m lower than today, so that the coast was at least 20 km further out to sea than it is now. Considering these points and the fact that the traps might migrate beachwards with increased sea levels, they would still have had to be built and mantained. Avery (1975) has proposed that the traps visible to-day were built between 3000 and 1700 years ago. I believe, however, that they may be as old as 4500 or 5000 years ago on evidence of small sized fish i.e. southern mullet, strepies and klipfish present in the Nelson Bay Cave sequence around that time (Inskeep 1987).

9.6: Evidence for fishing practices in the rock art

Although rock art sites are common in the western Cape, there are very few sites that depict fish, fishing equipment or fishing scenes in the research area. We know that site distribution is partly a factor of survey intensity and the availability of caves and shelters with suitable rock surfaces on which to paint (Maggs 1969, 1971, 1967; Manhire 1981, 1984; Parkington & van Rijssen 1983; Manhire *et al.* 1983, 1984; Parkington 1989; Yates *et al.* 1985, 1986; Yates & Manhire 1991; Parkington *et al.* 1986; Parkington *et al.* In Press). A detailed survey of over 2500 rock art sites from the west coast through the sand veld into the Olifants River valley, along the foothills and edges of the Cape Fold Mountain Belt has yielded only two paintings of fish. One was discovered at EBC on the west coast and the other at Klein Tee Kliphuis in the Cederberg. This would suggest that fishing scenes are rare and are seldom depicted among the numerous painted figures of animals, humans, and hunting equipment (Manhire pers. comm.).

The absence of fishing scenes and fishing equipment from the rock art in the western Cape is curious since more than thirty paintings of fish, sea mammals and fishing scenes have been found associated with the rock art along the south-east coast and in the interior of South Africa (Clark 1959; Schoonraad 1962; Inskeep 1978).

Along the south-east coast in the Knysna district a representation of a whale on a thirty centimetre block of quartzite was discovered in a coastal cave, and similarly, at Klasies River Mouth a painted stone was found with some human figures and what appears to be four painted images that resemble dolphins (Inskeep 1978). In the George district near Ezelsjagt Poort a 'mermaid' scene was discovered (Clark 1959; Lewis-Williams *et al.* 1993), and towards the interior in the region of the Mpongweni mountains in Griqualand East, a number of fishing scenes were discovered depicting shoals of fish within close proximity to humans in boats or rafts with long poles or spears (Figure 9:7) (Vinnicombe 1960). A similar scene was reported by Goodwin in which a number of human figures in boats with long poles can be seen catching fish; each pole had a fish attached to it (Figure 9:8) (Goodwin 1949). Other fishing scenes reported from Lesotho and the Underberg district are mainly fish trapping scenes without the use of boats (Figure 9:9) (Vinnicombe 1961; Smits 1967). Paintings and engravings of individual fish have been recorded in a number of different areas in South Africa and the execution of these fishing scenes suggests strongly that the depiction of fishing activities does take place amongst the rock art in the north-eastern and central regions of South Africa (Schoonraad 1962; Inskeep 1978).

9.7: Historical evidence for indigenous fishing

The fishing practices and equipment of the indigenous groups of the south-western Cape have been very sparsely recorded, although a number of accounts give some descriptions of fishing activities in and around the Cape Peninsula (Raven-Hart 1967, 1971). The use of rod and line fishing at the Cape was reported on as early as 1652 in Van Riebeeck's Journal:... "fishermen .... who subsist by fishing, without boats, from the rocks with little fishing lines. On this they are very keen" (Thom 1954 :II, 83). Another entry recorded in 1657 indicated that the Dutch bought ten oxen load of white steenbras ..." they (the local indigenes) had killed ... with assegais in a lake (or Flea) at the Bay False" (Thom 1954 :II, 83)

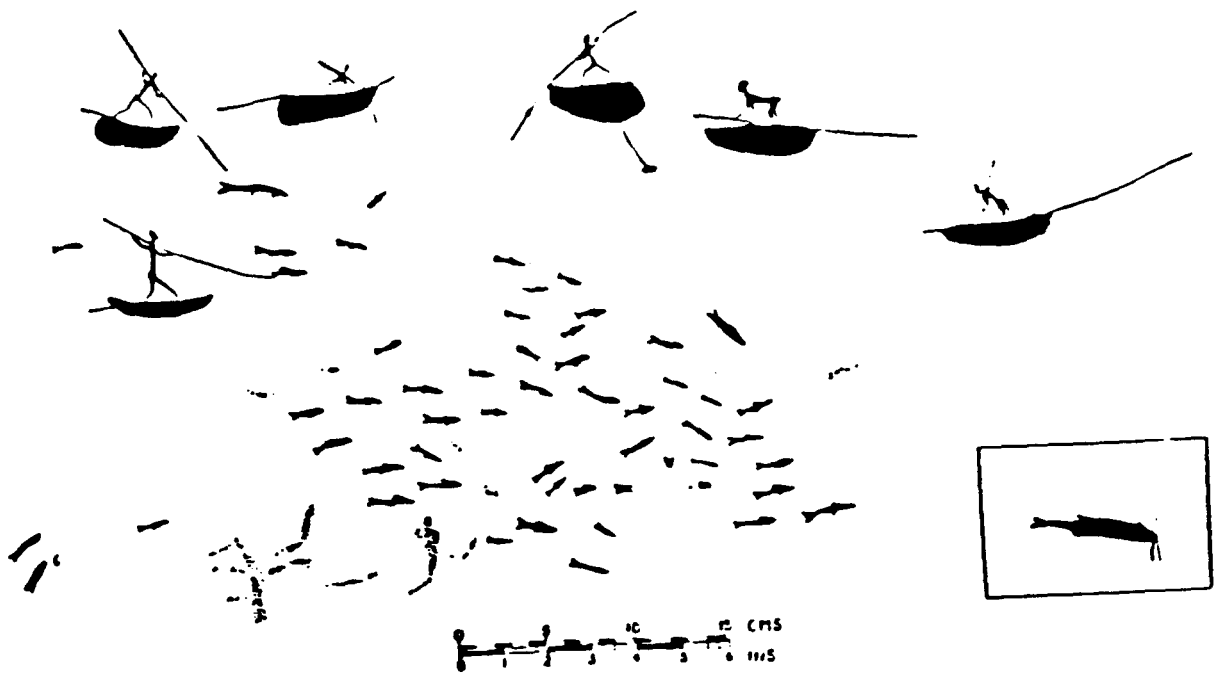

Figure 9:7. A fishing scene with human figures in boats with long poles catching fish. (after Vinnicombe 1960).

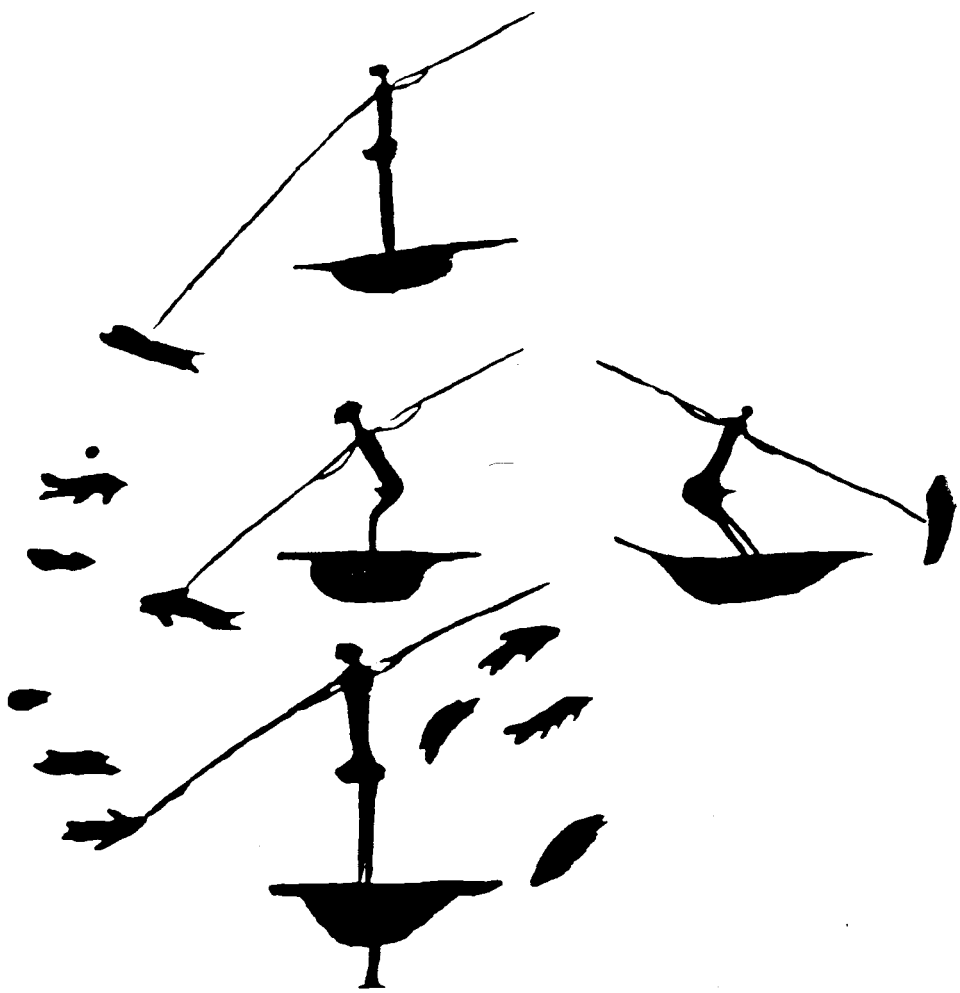

Figure 9:8. A painted fishing scene in the Mpongweni mountains in Griqualand East (After Goodwin 1949).

Figure 9:9 A painting of a fishtrap on Bamboo mountain, Underberg District, Southern Natal. A fishing scene from Botsabelo, Lesotho. A (after Vinnicombe 1961).

A number of other accounts can also be found in Schapera and Farrington (1933) of indigenous groups fishing along the coast on the Cape Peninsula. A number of references can be found in Raven-Hart (1971: 34), referring to Khoi who do not know how to fish, and to fish washed up on the beaches that are collected and eaten. Grevensbroek, speaking of the inhabitants of the Cape Peninsula states that "they also eat sea fish and river fish, even shellfish" (Shapera and Farrington 1933: 179). The Namaquas have also been reported to dislike fish (Alexander 1838, 2:84). There is also a suggestion that there may have been a taboo against eating fish without scales (Ten Rhyne in Shapera & Farrington 1933:103, 129). However, general observations recorded by Dutch explorers who went into the interior indicate that fishing did play a part in the economy of the people that lived there. During Danckaert's expedition into the Olifants River valley in 1660, he sent back a letter to Van Riebeeck at the fort in Cape Town, informing him that they had come across a poverty stricken band of tiny people, who helped them cross the first range of mountains and who gave them some dried fish and honey (Thom 1954:3, 300). Thomson (1913) describes Hottentots as fishermen who utilise both the shore and rivers with different fishing equipment. "They take fish by angle, the net, the spear or pointed rod". (Thomson 1913:34) Before the arrival of the Dutch at the Cape indigenous groups made hooks with thorns and plaited grass and were quite knowledgeable in using a net (Thomson 1913).

Inland freshwater fishing by indigenous groups has also been reported by Lichtenstein (1815) and Barrow (1801, 1806) in the northern Cape. They observed hunter-gatherer-fishermen using basket traps, rock wall traps and fishing with lines and spears. Alexander (1838) recorded the use of conical baskets in the Fish River. The same type of basket traps are depicted in fishing scenes in the rock art of Natal and Lesotho (Vinnicombe 1961; Smits 1967).

Barriers or fishtraps made from stone and used in combination with baskets have also been recorded by Clark (1959) among present day Bushmen, while Wilcox (1965) saw disused stone fishtraps near the Riet River in the northern Cape. The spearing of a fish thought to be a *Barbus holubi* was recorded by Burchell (1824) in the Orange River. Groenewald (1961) report that during the breeding season the species *Clarias gariepinus* are clubbed or speared in large numbers even today while

migrating upstream, or when spawning in the marginal vegetation of dams or streams in the Orange and Fish Rivers.

Most archaeological sites excavated in the interior of the south-western Cape, along the Olifants and Doorn Rivers, have yielded very small samples of fish remains. At Klipfonteinrand, a site in the Cederberg only three *Labeo seeberi* were recovered and Andriesgrond, which is situated next to the Clanwilliam dam on the Olifants River, yielded some bones of the Clanwilliam yellow fish *Barbus capensis*. At De Hangen some freshwater fish bone was present but has not been identified. Other sites excavated by Halkett and Smith along the Doorn River produced only about four fishes (Parkington & Poggenpoel 1971; Parkington 1976a; Smith & Ripp 1978; Kaplan 1984; Anderson 1991; Halkett 1991).

In the northern Cape a greater reliance on fish as a staple food is evident among prehistoric groups who lived along the Orange and Fish Rivers (Robertshaw 1978). In this area the climatic conditions are more arid than in the Cape Fold Belt, with fewer water sources, and this restricts the availability of plant foods to winter or spring. During the summer months the Orange River is the only permanent water supply and settlement along its banks is essential for both hunter-gatherer and pastoral communities. The fish available in the river systems would have acted as a welcome supplement in the absence of corm-bearing geophytes and other plant foods which are more readily available along the foothills and valleys of the western Cape mountains during summer (Parkington & Poggenpoel 1971; Milton 1978; Meterlerkamp & Sealy 1983; Sealy 1986; Liengme 1987).

All excavations conducted in the Cape Fold Belt thus far have yielded no fish remains in deposits dated older than 2000 years, which suggests that before the arrival of pastoral communities in the area freshwater fishing did not play an important role in the economy. Likewise, fishing seems to have been at best a secondary economic pursuit amongst both hunter-gatherer and pastoralist communities during the last 2000 years at inland sites in the south-western Cape.

An interesting point is that whenever indigenous groups were seen fishing along the coast or inland, no mention was made of any domestic stock in their presence. Even the groups seen in the vicinity of the Cape Peninsula, referred to as Strandlopers or Watermen, never had any sheep

or cattle herds. Fishermen sometimes called Soaqua had some cattle but no sheep, and only subsisted by fishing from the rocks (Moodie 1960; Thom 1952). It would seem that the true fishermen amongst the Khoi and San groups were those who had either lost their herds or never acquired any, and those who had large herds of cattle and sheep spent very little time fishing (Robertshaw 1977; Smith 1985). From these observations it can be concluded that non-herding communities that rely heavily on natural food resources are much more prone to subsist through fishing than others who practise herding of domestic animals. This hypothesis is supported by the archaeological evidence recorded at Kasteelberg and other sites on the Vredenburg Peninsula (Robertshaw 1978; Smith 1985).

9.8: Conclusion

By examining all the evidence set out above it is quite clear that the development of fishing equipment started out with a simple method of line fishing with a double pointed bone called a fish gorge. This method was later improved by using line weights and eventually mass trapping methods were introduced. Fishing also seems to have played different roles in the economy of the indigenous peoples who occupied the interior and those who utilised the coastal regions in the south-western Cape.

It is also clear that painted fishing scenes and related activities have been executed by prehistoric painters in southern Africa, which makes the absence of these painted scenes from the south-western Cape rock art even more curious. By looking at a number of different scenarios for the absence of fishing scenes in western Cape rock art, it is possible that the low yield of fish remains in inland archaeological sites may suggest that scheduling of visits by hunter-gatherer groups and fish spawning runs may not have coincided in the Olifants and Berg River valleys (Parkington & Poggenpoel 1971; Kaplan 1984; Halkett 1991; Anderson 1993). If we assume that prehistoric groups lived a transhumant existence, and (a) they visited the Olifants and Berg River valleys only for some part of the year, (b) and that such visits did not coincide with the major spawning runs of fish in the river systems, then the chances of catching large quantities of fish would have been minimal.

Secondly, if the depiction of fishing scenes is a late phenomenon in the rock art of southern Africa, as suggested by Vinnicombe and Smits for the Lesotho and Underberg areas, then the non-depiction of fishing scenes in the western Cape rock art maybe due to its greater antiquity.

Thirdly the presence of fishing scenes in other parts of southern Africa would argue against the hypothesis that fishing is such a primary economic activity that it was unnecessary to show it in the rock art, as has been suggested for the non-depiction of plant gathering activities amongst Bushmen paintings. A more likely scenario is that after the arrival of pastoral communities in the western Cape round about 1800 years BP, the impact of large herds of domesticated animals may have created such social disruption and stress that the emphasis was placed on trance related imagery rather than on painting everyday activities such as plant gathering and fishing scenes.

CHAPTER 10

SUMMARY

Although ichthyoarchaeology is regarded as a young discipline, the analysis of fish assemblages, as a branch of archaeozoology, has become an integral part of the interpretation and understanding of riverine and marine coastal settlement and diets. Fish remains have been recovered from a variety of archaeological sites dated to the Middle Pleistocene, Upper Pleistocene and Holocene. Although the remains may have undergone taphonomic changes over time, they are often in a state of preservation that enables specific taxonomic identification to be made. The development of ichthyoarchaeological studies in South Africa started only a few decades ago and at first may have been rather simplistic in its approach. The level of analysis has allowed us to avoid the misrepresentation of species in fish assemblages by using all body parts for the identifications of various taxa. It is crucial to identify the correct species within an assemblage especially when the species composition is used to interpret habitat exploitation and fish behavioural patterns. Later analysis of fish assemblages from NBC showed the potential fish remains had, to help interpret palaeoclimatic changes as well as establishing fish procurement strategies during the late Pleistocene and Holocene. In recent years fish research associated with coastal, riverine or lacustrine prehistoric settlements have become multi-disciplinary in its approach and enjoy a much wider range of scientific methods to draw from.

10.1: Fish exploitation in the context of late Pleistocene and Holocene environmental changes

The earliest evidence of marine and estuarine fish exploitation along the west coast of South Africa during the late Pleistocene and Holocene was

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10.1: Fish exploitation in the context of late Pleistocene and Holocene environmental changes

The earliest evidence of marine and estuarine fish exploitation along the west coast of South Africa during the late Pleistocene and Holocene was

discovered at EBC near Elands Bay. It has been concluded that the earliest fish bone residues represent exploitation of the estuary mouth which has undergone a number of geomorphological changes during the past. This evidence is supported by the presence of only one species southern mullet *Liza richardsoni* and the high incidence of vertebrae compared to cranial elements in the lower assemblages in the cave. It is also assumed that the heads were removed and consumed at the estuary mouth near the coast and that the trunk regions of the fish were taken inland to EBC where the vertebrae without head elements were discarded. This pattern is reversed between 10 000 and 9600 years ago when a rise in sea level brought the coast within a short distance from the cave. Geomorphological evidence confirm from about 18 000 years ago, transgressive water movements started to rise from -120 m and the landscape saw some of the more drastic environmental changes which coincided with the last glacial maximum. Since it was cooler between 18 000 and 14 000 years ago the rate of sea level rise would have been slower. A sudden increase of sea level rise was experienced round about 13 000 years ago, which saw large tracts of coastal foreshore submerged and the creation of a new coastline some 12 to 15 kilometres from its present position. With rapid transgression, the drowned river mouth created estuarine conditions which became exploitable from the cave and the first indications of fishing in the form of fish residues is visible in the archaeological record at EBC after 11 000 years BP. The increase of marine elements such as shellfish, sea-birds and seals in the EBC sequence at this time, reflects the utilization of the coast as part of the site catchment and the low incidence of vertebrae are due to the processing of fish to be taken even further inland.

First this would imply that the cave during this period were used as a fish processing site and secondly that the site were occupied for only some part of the year on a seasonal basis. As the shore approached to within 5 kilometres of the cave some of the higher lying areas between incised valleys protruded as islands round about 11 000 years ago. Once the coast became part of the site catchment, coastal resources became exploitable to such an extent that the most concentrated use of the cave seems to have taken place soon after this period. The analysis of fish assemblages from a number of sites along the coast suggest that sites which are situated within close proximity to the coastline, reflect a procurement strategy where

vertebrae are always under-represented. This confirms the hypothesis that coastal sites are mainly used as fish preparation sites and that only a portion of the catch is normally consumed, whilst the rest is taken elsewhere to sites further inland. The low incidence of fish vertebrae in the fish residues retrieved from sites such as TC and SC in the vicinity of the Verlorenvlei, seems to support the hypothesis that sites within close proximity to fishing habitats are used as fish processing sites and that the fish are consumed later at sites possibly further inland.

During the Holocene maximum from about 8000 years onwards the sea rose to +3 metres above modern sea level. The rise in sea level drowned the vlei basin and the Verlorenvlei became a lagoon that reached up some 15 kilometres and spanned more then 100 metres across near the mouth (Parkington in prep.). The lagoon became fully tidal with mudflats and housed a variety of fish species similar to the present day Langebaan Lagoon but on a smaller scale. In direct response to the drop in sea level and an increase in siltation from the river and sea, the Verlorenvlei started to change its position and outflow in a southerly direction. After 4700 years in the EBC sequence the fish assemblage display two important changes. An increased diversity of marine taxa and a change from predominantly juvenile to exclusively adult white steenbras. This greater range of marine species may be due to an increased use of the marine habitat or it may reflect the collecting of some species that was washed ashore during a cold upwelling episode. Some of the marine species that occur shortly after this period do not continue through the rest of the sequence, i.e. snoek *Thyrsites atun* and kingklip *Xiphiurus capensis* which are deep-water fish and points towards beach collecting rather than fishing. The difference in fish size seen between package eight and thirteen could also be the result of a seasonal change when fish was exploited at the estuary mouth.

With the lowering of sea level the exposed beach sand on the seabed was redeposited north of the vlei mouth through wind action, which played a major role in redirecting the course of the river. As sea level continued to drop to present day levels the reappearance of stretches of rocky shoreline allowed people to fish and collect shellfish along the beach and vast shell middens accumulated along the coast during this period. After 1600 years BP the fish fauna associated in the upper packages in the EBC sequence

becomes rather impoverished which may be in direct response to the closure of Verlorenvlei as an active estuary.

10.2: Fish procurement methods

The procurement of fish as a prehistoric subsistence strategy in coastal sites are very sparse, although ethnographic and ethnoarchaeological research indicate that pre-contact traditional fishing technologies that are associated with freshwater fishing suggests that a wide range of techniques which include fishing with gorges, hooks, weirs, fish-traps, small nets, spears, harpoons, leisters, thrust baskets, stationary basket traps, and even poison are used throughout many parts of Africa (Maclaren 1958; Stewart 1989). Many of these methods used seems to be associated with freshwater fishing rather than coastal exploitation. Execpt for one or two methods the majority of the activities are communal and needs the co-operation of a number of people to succeed.

Fishing implements or methods are widespread across the African continent and many are of pre-contact antiquity. In South African sites the earliest form of procurement is the small double pointed bone point called the 'fish gorge', which are found in association with fish bone assemblages. Often they are tied to fibres or vines and sometimes several gorges may be attached to the same line usually baited (Stewart 1989). The gorges are only found in deposits dated to the late Pleistocene and early Holocene and very few archaeological sites that have been dated to the middle and late Holocene period have yielded fish gorges, which may suggest that the fish gorge method was discontinued and replaced by another method of capturing fish.

The earliest form of fish hook made of bone appear round about 4000 years ago but seems to have a limited distribution which include the Transkei, Kwa-Zulu Natal and Lesotho. They are also associated with riverine sites where aquatic fishing habitats were exploited. No implement have been found in coastal sites that resemble a fish hook other than the fish gorge and it is possible that a different raw material may have been used i.e. wood or thorn that may not have survived the archaeological record.

The use of fish-traps as a procurement strategy to acquire fish have been recorded ethnographically by Avery (1975). It has also been documented in

the rock art of southern Africa associated with riverine fishing. Although no archaeological site have been excavated which are directly associated with a fish-trap, many traps have been recorded along the south-east coast where large numbers of coastal shell middens have been located. Since many of the coastal shell middens dates to the last two millennia, the fishtraps visible on the coast today are situated within the intertidal zone which suggest that they could only have been functional at a time when sea level had reached its present mean some time after 3000 years ago. This would imply that the people responsible for the shell midden accumulations along the coast also made and used the fish-traps to procure fish. Since the trapping of fish with fish-traps or nets is non-selective, the composition of taxonomic abundance and size variation within shell middens that are closely located to fish-traps, may reveal differences in the fish composition that will make it possible to separate those that may have used fishtraps or nets as a procurement strategy.

The early settlers in the Cape recognised a basic distinction between groups that owned herds of cattle and flocks of sheep as pastoralists (referred to as Khoi or Hottentots), and those without any live stock and lived by what is now referred to as hunting, gathering and fishing (called San or Bushmen). Confusion in the grouping and naming of the two economic groups persists throughout the ethnohistoric literature and the name Strandloper was given to any group that were encountered along the coast (Raven-Hart 1967; Avery 1975). The clearest distinction which characterises indigenous groups at the Cape can be made on economic grounds. San hunter-fisher-gatherers (Bushmen, Soaqua, Sonqua, Watermen and Fishermen) subsisted by utilising a wide range of resources inland and on the coast, possibly on a seasonal basis, and did not manage stock although sheep and cattle may have been opportunistically stolen (Schapera 1930; Schapera & Farrington 1933; Raven-hart 1967; Deacon 1976; Buchanan 1986; Parkington *et al.* 1988). On the other hand Khoi groups (Khoi Khoi, Hottentots and Saldanhamen) were pastoralists who managed domestic stock, but also hunted and gathered and moved seasonally on a annual basis from the coast to inland pastures (Schapera 1930; Klein 1986; Smith 1986).

Although there were differences socially and economicaly between these two groups the problem of recognising these differences in the archaeological record when some hunter-gatherers acquired stock and

becoming herders whilst some herders losing stock and reverting to hunting and gathering is difficult to assess. Recognising the Khoi/San distinction despite their economic differences is a problem unsolved, since they also share many cultural and physical characteristics and in many cases share the same sites in the landscape which make it difficult to separate the residues left behind by each group. Both groups may have been responsible for constructing the fish-traps but since the building and maintaining the traps is rather labour intensive a type of semi-sendentary way of life had to be adopted to monitor the traps between high and low tides which favour the Khoi Khoi groups rather then the San groups who are nomadic and never stay in one place for any length of time.

10.3: The fish procurement and processing in historical sites

The analysis of fish assemblages retrieved from historical sites in the south-western Cape high lighted a number of issues relating to the procurement, processing and supplying of fish, from outposts to the settlement in Cape Town. The early European settlers in the Cape introduced new techniques to procuring fish with boats and nets which made it possible to capture deep-water species not exploited by the hunter-fisher-gatherers. At the same time the method of processing fish has left butchering marks on some fish cranial elements which have not been recorded in prehistoric fish assemblages before. According to early documentary sources Oudepost I (OP1) on the Churchhaven Peninsula and the Posthuys at Muizenberg were stations to provision passing ships with water, vegetables and meat whilst fish, penguin and bird eggs, train oil from seals and ostrich eggs were to be exported to the settlement at the Cape (Leibbrandt 1902; Böeseken 1961). The analysis of the fish remains showed that on the basis of the southern mullet size discrepancy that exists between OP1 and Castle samples, it would appear that very few if any southern mullet from OP1 was exported to the Castle. At the same time none of the highly esteemed warm loving fishes found in the Posthuys assemblage near Muizenberg reached the Castle. This evidence would imply that the economic trading operations recorded in the written records between the colony and the outposts may not always reflect the true amounts of provisions supplied to the colony and at the same time outposts may not have received the supplies as indicated in

the records. If such an insignificant statistic as the size of southern mullet can expose discrepancies between the written records and the archaeological evidence, then direct application of historical accounts and ethnohistorical observations should be carefully approached when used as a tool to interpret or reconstruct historic and colonial life.

10.4: Fishing localities

The analysis of fish assemblages from archaeological sites in the three localities i.e. Elands Bay, Langebaan Lagoon and False Bay, has shown that it is possible to predict which fishing habitat was utilised by prehistoric hunter-fisher-gatherers on the basis of taxonomic abundance and diversity. At Elands Bay the fish assemblages are dominated by southern mullet *Liza richardsoni*, white steenbras *Lithognathus lithognathus*, white stumpnose *Rhabdosargus globiceps* and flathead mullet *Mugil cephalus*. The presence or absence and size distribution of these species through the EBC sequence is directly related to the changing conditions and registers the environmental shifts that has taken place during the late Pleistocene and Holocene in the Verlorenvlei ecosystem.
Sites which are not situated within close proximity to rivers or estuary mouths, but located along the sea shore, are dominated by hottentot *Pachymetopon blochii*. This have been demonstrated by the Paternoster and Duiker Eiland sites on the Vredenburg Peninsula which are situated along the coast with no river or estuary within the catchment area. Similarly this has also been supported by the False Bay sites. The Langebaan Lagoon fish assemblages points to differences in procurement strategies employed by the inhabitants of the sites analysed. The two sites examined showed that different species are dominant in the two samples. In the case of the prehistoric site Stofbergfontein the most common species is southern mullet *Liza richardsoni*. This may be due to the use of a primitive method such as the fishtrap method, whilst at the historic site OP1 the procurement methods include the use of boats, nets and hooks which resulted in a large range of species being caught as well as white stumpnose *Rhabdosargus globiceps* becoming the dominant species taken by the inhabitants of the site.

Since False Bay is influenced by the Agulhas Current the water temperature are some degrees warmer then the Benguela Current and house a number of warm water species of popular angling fish that does not penetrate into the colder waters of the west coast. A number of fish that inhabit the south-east coast literal zone commonly occur in prehistoric fish assemblages and its presence at sites situated on the south-west coast may point to fish being imported from False Bay to sites like the Castle in Cape Town. Most of the prehistoric fish assemblages examined from excavated sites which are not within close proximity to river systems are dominated by hottentot *Pachymetopon blochii*, whilst others such as the Gordon's Bay shell midden which is situated near the Lourens River is dominated by white steenbras *Lithognathus lithognathus* and white stumpnose *Rhabdosargus globiceps* (van Noten 1974). This differentiation of marine taxa verses estuarine taxa and its relative abundance in archaeological sites can be used as a means to reconstruct past fishing localities in a changing landscape.

The analysis of fish assemblages in this study have demonstrated that the range of fish taxa present in the archaeological record in coastal sites along the south-west coast of South Africa can be directly associated with the exploitation of certain fishing habitats in the past. Although the presence or absence of some taxa can be related to the utilization of certain procurement strategies, on the hole, the species identified in the sites indicate that it is possible to seperate habitat selection from methods of procurement during the last 11 000 years. The identification and interpretation of fish bone assemblages have also given us insights into related issues such as palaeoenvironmental changes and seasonality. Apart from the shellfish, fish remains forms a major component of the assemblages excavated and indeed may have been one of the main reasons for coastal visits.

In conclusion, the analysis of fish remains has played an important role in paving the way to understand prehistoric aquatic and marine coastal peoples diets. It has also indicated the value and validity of detailed analysis of fish assemblages in conjunction with other bioarchaeological indices that can enhance the interpretation of past paleoclimates, seasonal behavioural patterns and the development of fishing strategies during the late Pleistocene and Holocene. The usefulness of a number of scientific

techniques that can be applied to fish bones, places itchthyoarchaeology within a unique position to emerge as one of the more valuable disciplines that can improve our prediction and reconstruction of resource availability, habitat selection and the history of past human responses to environmental change.

APPENDIX A

Appendix A is a list of the new stratigraphic layers and radio carbon dates for Elands Bay Cave (EBC) and Tortoise Cave (TC).

Elands Bay Cave (EBC)

Unit	**Package**
AMIN= Amin, DOSU= Surface of Dolly,	1
KEKA= K,Kaunda, POIS= Poison,	1
SDUN= Surface and dung,SURF= Surface.	1
KEKA	1
Dated Unit	**2**
NKOM Sq. A8 320 ± 50 (Pta-1815)	
AWTW Sq. C8 330 45 (Pta 5821)	
AWTW= Ash with twigs,	2
CASA= Casblanca, FNLA= Fnla,	2
HAMM= Hammond-Tooke, IANS= Ian Smith,	2
MONI= Monica Wilson, MUZO= Muzorewa,	2
NKOM= Nkomo, SELA= Haile Selassie,	2
SITH= Sithole, STWI= Surface with twigs,	2
TODD= Garfield Todd, TWIG= Twig lens 1,	2
WELE= Welensky.	2
SENG= Senghor,	2

Dated Unit **3**
MRSB Sq. Y7 AD 1436, 500 ± 45 (Pta-5813)
POTA Sq. X2 AD 254, 1790 ± 50 (Pta-5820)
KEPL Sq. X3 2100 ± 20 (Pta-6511)
JECH Sq. F7 1310 ± 40 (Pta-5595)
BARR Sq. C3 1350 20 (Pta-6138)
BUTH Sq. A3 1400 ± 50 (Pta 6132)
BUTH Sq. A5 2790 ± 50 (Pta 5816)

ABRU= Andre Bruyns, GEOB= George Best, 3
BARR= Barry Richards (UPPER), 3
BUMO= Burnt Mobutu, JECH= Jesus Christ /Ash, 3
CNET= Crust at base of Neto, 3
HNET= Hearth at base of Neto, 3
HMRS= Hearth in MRS Balls, 3
ROBE= Holden Roberto, MOBU= Mobutu, 3
MRSB= MRS Balls, NETO= Neto, 3
SAMO= Samora Machel, DOLL= Dolly, 3
BAEC= Base of El Chama, BUTH= Buthelezi, 3
COPE= Copernicus, ELCH= El Chama, 3
GALI= Galileo, POTG= Grey potato, 3
KEPL= Kepler, MATZ= Matanzima, 3
PIEC= Pit in El Chama, POTA= Potato, 3
POTS= Salty Potato, SMIT= Smit, 3
TOMM= Top of Maji Maji, CCLA= Cassius Clay. 3

Dated Unit **4**
EDDI Sq. C7 1040 ± 50 (Pta-5822)
BRST Sq. C8 1280 ± 50 (Pta-5819)

BARN= Barnacles from rear of Cave, 4
BEDP= Bedding patch (not Dolly), 4
DOL2= Dolly Spit 2, 4
EBHE= Eddie Barlow (Hearth), 4
EBTP= Eddie Barlow (Twiggy Patch), 4

ALEN= Ash Lens, 4
ALMJ= Ash Lens above Mick Jagger, 4
BING= Bing Crosby, BHOP= Bob Hope, 4
BRST= Brian Statham, ELPR= Elvis Presley, 4
LIAP= Lens above Pit, PIIN= Pit infill, 4
TCHA= Tchaikovsky. 4

Dated Unit **5**
GADD Sq. B9 1680 ± 40 (Pta-5815)
LARM Sq. E9 2190 ± 25 (Pta-5810)
RAYI Sq. C9 1520 ± 80 (GaK 4337)

DAKA= D.Kaye, 5
DOLA= Dorothy Lamour, FRRI= Fire below RRI, 5
GADD= Gaddaffi, HEAR= Hearth I/II/Gaddaffi, 5
MIJA= Mick Jagger, MRSN= MRS Nkrumah, 5
RAYI= Ray Inskeep, APAT= Alan Paton, 5
ALAG= Ash lens above Germaine, 5
CKEE= Cristeen Keeler, EVGO= Evonne Goolagong, 5
GEGR= G.Greer, LARM= L. Armstrong, 5

Dated Unit **6**
GSFB= Sq. C6 3590 ± 60 (Pta-5594)
LBED= Sq. D5 3450 ± 50 (Pta 0841)
LBED= Sq. D5 3510 ± 45 (Pta-0687)

BARI= Barry Richards (Lower), 6
GSFB= Greyish soil with frag. Be. 6
LBED= Lower Barlow Eddie, NENY= Neo-Nyerere, 6
NYER= Nyerere, RING= Ringo Starr, 6
UBED= Upper Barlow Eddie. 6
EDDI= Eddie Barlow 6

Dated Unit **7**
RETS Sq. YB 3290± 60 (Pta-5811)

ACHE= Achebe, 7
BOMM= Bottom of Maji Maji, DIDO= Dido, 7
MAJI= Maji Maji, MANT= P. Mantas, 7
MASI= Margaret Singana, RADS= Radie Smit, 7
RETS= Retha Smit. 7

Dated Unit **8**
JOFR Sq. C9 3780 ± 60 (Pta-5806)
JOFR Sq. C9 2950 115 (GaK 4339)
SOYI Sq. Z8 3780 ± 85 (Pta-1816)

BSJF= Brown soil in Joe Frazier, 8
BJFR= Burial 1: Bottom of J.F., 8
CHOW= Chowclay, JOEF= Joe Frazier, 8
JFR1= Joe Frazier 1, JFR2= Joe Frazier II, 8
LMLE= Louis & Mary Leakey, SWGO= Sewgolum, 8
DBRA= Dollar Brand, 8
HIDB= Hearth in Dollar Brand, OBOT= Obote, 8
PASO= Para-Soyinka, SOYI= Soyinka, 8
TOPD= Top of Dollar Brand. 8

Dated Unit **9**
SHAK Sq. B4 4370 ± 60 (Pta-5313)
BARH Sq. Y4 3940 ± 60 (Pta-5317)

ALBK= Ash lens in base of Karate, 9
BARH= Base of Rhino, 9
BNEF= Bottom of Nefertiti, 9
BRRH= Brown Rhino, BURH= Burnt Rhino, 9
BSAS= Bottom of Sans Souci,DAAN= Dingaan, 9
ELEP= Elephant, HIPO= Hippo, 9

JUDO= Judo, KARA= Karate, KUFO= Kung Food, 9
NEFE= Nefertiti, NIMO= Nico Mouton, 9
PGRO= P. Groenewald, PSHA= Pre-Shaka, 9
RHIN= Rhino, SASO= Sans Souci, 9
SAVI= Savimbi, SEKH =Sertse Khama, 9
SHA2= Shaka II, SHAK= Shaka, 9
TUTA =Tutankhamun, UITT= Uit en Tuis, 9
WAYA= Dingiswayo A, WAYB= Dingiswayo B. 9

Dated Unit **10**
BURO Sq. B4 8860 ± 90 (Pta-5305)
MARO Sq. B4 7910 ± 80 (Pta-1872)
MARO Sq. A4 8340 ± 80 (Pta-1871)
BURO Sq. B4 8860 90 (Pta 5305)

BERO= Bedding Robeson, 10
BERI= Bedding Robeson 1, 10
BER2= Bedding Robeson 2, 10
BMAR= Burnt Maroon Robeson, 10
MARO= Maroon Robeson, NERO= New Robeson, 10
OLIV= Olive Schreiner, SPAS= Spassky, 10
WINK= Winnie Kriel, 10
BLIR= Below Limpet Robeson, 10
BURO= Burnt Robeson, LIRO= Limpet Robeson, 10
PWBO= PW Botha, WIRO= White Robeson, 10
BOBM= Bobby Moore, EUSE= Eusebio, 10
JVOR= John Vorster, PKER= Paul Keres, 10
PARO= Paul Robeson, PAR1= Paul Robeson 1, 10
WEBB= Harry Webb, 10
ALAB= Ash Lens above Brush, BETT= Betty, 10
BRUS= Brush, MAGG= Maggie, SPAD= Spade. 10

Dated Unit **11**
Soil Sq. Y6 8920 ± 90 (Pta-5808)

ALSO= Ash Lens above Soil, 11
BSAN= Brown soil above Neptune, 11
BURR= Burrow, HSOI= Hearth in Soil, 11
HOLE= Hole, HOCO= Hole Content, 11
LITH= Lens in top of Hole, 11
MUSO= Mussel Soil, SLOP= Slope Cleanings, 11
SOIL= Soil, SOSU= Soil Surface, 11
SOME= Something Else, 11
BOGA= Base of Grey Ashes, 11
CHAU= Chauvinism, AGB1= Grey ash in GBS 1, 11
NIKO =Nikon. 11

Dated Unit **12**
Gnome Sq. Z4 9510 ± 90 (Pta-5824)

ALGN= Ash Lens above Gnome, 12
ALZC= Ash Lens above Zostera, 12
ASHL= Ash Lens, ELFO= Elf, 12
GNO2= Gnome 2, GNOM= Gnome, HOBI= Hobbit, 12
ORCO= Orc, TOPG= Top of Gnome. 12

Dated Unit **13**
NEPT Sq. Z4 9640 ± 90 (Pta-5306)
BSBP Sq. C5 9600 ± 90 (Pta-686)

AAZC= Ash Lens adjacent to Zostera, 13
APOL= Apollo, ATLA= Atlantis, 13
BENE= Below Neptune, BEPW= Below P.W. Botha, 13
BLEN= Black Lense, BRNE= Brown Neptune, 13
BSBP= Brown soil below Pele, 13
BSJH= Brown soil below Jimi Hendrix, 13
BSP1= BSBP I, BSP2= BSBP II, BURN= Burnapena, 13
DECE= D.C., DUCA= Ducati, FAKE= Fake Burnapena, 13

GONE= Gone, GREL= Greenish lense, 13
HONE= Hole in Neptune, JAJO= Janis Joplin, 13
JIHE Jimi Hendrix, LIMP= Limpopo, 13
LOBO= Louis Botha, NEPT= Neptune, 13
NUIS= Nuisance, PSEI= Poseidon, 13
SOLE= Sonny Leon, YASM= Yasmin, 13
ZAMB= Zambezi, ZOST= Zostera Capping. 13

Dated Unit **14**
CRAY Z5 9950 ± 270 (Pta 2592)
CRAY Z6 10 000 ± 90 (Pta 2481)

ALAC= Ash lens above Crab, 14
ALBL= Ash lens below Lobster, 14
ALBC= Ash lens in base of Crayfish, 14
BACR= Base of Crayfish, CRAB= Crab, 14
CRAY= Crayfish, FLIP= Flipper, 14
GRLC= Green lens above Crayfish, 14
GLAC= Green lens adjacent to Crayfish, 14
LOBS= Lobster. 14

Dated Unit **15**
Dust Sq. Y2/Y3 10 620 ± 100 (Pta-6758)
SMOK Sq. X3 10 660 ± 100 (Pta-5369)
SMOK Sq. Y3 10 840 ± 70 (AA-5833)
FOAM Sq. X2 10 460 ± 80 (Pta-5336)
PBGB Sq. C5 10 640 ± 110 (Pta-732)
GBAN Sq. G3 10 700 ± 100 (Pta-737)

BEST= Below Stones, 15
FRTU= Friar Tuck, MAID= Maid Marion, 15
ROHO= Robin Hood, ASHE= Ashes, BAAD= Baade, 15
HBDU= Bott. of Dust/Hearth below, BUBB= Bubbles, 15
BSO1= Burnt Soil I, BSO2= Burnt Soil II, 15

BSO3= Burnt Soil III, DUST= Dust, FOAM= Foam, 15
FOCA= Foam Capping, GBAN= Gordon Banks, 15
HIBB= Hearth below Baade, HIAS= Hearth in Ashes, 15
SMOH= Hearth in Smoke, HASH= Hole in Ashes, 15
LEYA= Lev Yashin, OXYG= Oxygen, 15
PBGB= Pale Burnt Gordon Banks, 15
PIAS= Pit in Ashes, SMOK= Smoke, 15
VIKI= Viking, BEFO= Below Foreigner, 15
FORE= Foreigner, STRA= Stranger. 15

Dated Unit **16**
GBS1 SQ. B2 11 370 ± 110 (Pta-6756)
GBS2 SQ. B2 13 020 ± 130 (Pta-6757)
PLGB F5 10 090 ± 65 (UW 0193)
KAMA E4 11 070 140 (UW 01920)

AFPA= Above First Pale Ash, 16
BEDE= B. Devlin, BGBS= Base of GBS, 16
BRSS= Brown Soil Surface, 16
CBCA= Ced's Birthday Cake, 16
FIPA= First Pale Ash, GB1A= GBS1A, GB1B= GBS1B, 16
GB1C= GBS1C, GB1A= GBSIIA, 16
GBS1= Grey Brown Soil Series I, 16
GBS2= Grey Brown Series II, 16
GBSH= GBSS one and a half, GBSO= GBSO, 16
HBGB= Hearth in Base of GBS 1, 16
HG1A= Hearth in GBS 1A, HGB2= Hearth in GBS II, 16
KAMA= Karl Marx, LGB1= Limpet Lense in GBS 1, 16
LOOS= Loose Brown Soil = GBS?, 16
PLGB= Patella Lense in Base of G. 16
SLAG= Slag, SPO1= Spit I. 16

Dated Unit **17**
SPO2= Spit II, SP2B= Spit IIB. 17
DSO1= Sounding: Spit I, 17
DSO2= Sounding: Spit II. 17
SPO3= Spit III, 17

Dated Unit **18**
OBS1= Orange Black Series I 18
CSS1= Calcified Hole in SS1, 18
SOS2= Soft Series II, 18
OBS2= Orange Black Series II 18

Dated Unit **19**
S0SE Sq. Y4 11 415 ± 80 (AA-5834)
SOSE Sq. C3 13260 ± 120 (Pta 6761)

SOSA= Soft Series IA, 19
SOSE= Soft Series I, 19
SPO4= Spit IV, 19
DSO3= Sounding: Spit III. 19

TORTIOSE CAVE (TC)

THE POTTERY LAYERS

Layer 1A are made up of surface deposits removed by Robey and the cultural and faunal material show that it is partly mixed. It was decided not to include it in the final analysis.

Layer 1A:

(Dated unit: FUB 760 ± 50 BP (Pta-3600)

Surface [squares C, F, G, H, I, 12, 13, J, J2, J3, K, K2, K3, L, T, T2, X, X2, X3, Y, Y2]
Topsoil, Surface Scrapings [in squares as for surface], Degas, Degas and Topsoil, Back of Degas, Bendix, Constable, Niellson, Oscar, Twig Len, Base of Twig Len, Dust over Bedding, Grey Ash with Dung pellets (GAWDP), Foldup Bedding (Fub), Base of Foldup Bedding, Shell and grass, Bedding and shell, Bedding A, Base of Bedding A, Bedding B, Hearth next to Bedding A, Hearth below Twig Len.

LAYER 1B:

Cacophonix, Bedding C, Bedding D, Fragmented Bedding, Bedding on Max, Hearth below Max, Loubie (Looby, Louby, etc.) Grey Loubie, Burnt Shell, Fragments, Hearth on Gauguin, Dogmatix, Base of Dogmatix, Cleanings around Hearth.

LAYER 2A:

(1660 ± 45 BP (Pta-585)5; dated unit: Len).

Asterix, Zulu, Pissarro, Cleanings above Ernst/Gauguin, Ernst, Ernst/Pissarro, Gauguin, Ernst/Gauguin, Hals, Feature amongst Rocks, Below Loubie (under Loubie), Django, Len (Lennie, Layer Len), Fragmented Len, Back of Midden.

LAYER 2B:

(Dated unit: Fran 1580 ± 50 BP (Pta-3309).

Vincent, Dave, Sally, Josh, Kline, Roots, Rubens, Base of Rubens, Felix, Ivan, Jasper, Enigmatix, Fran, Bedding in Fran (Bedding in Base of Fran), Base of Fran, Back of Fran, Compacted Fran, Soil under Rubens.

LAYER 3A:

(Dated unit: Alvin 1680 ± 50 BP (Pta-3312).
(Dated unit: Turner 1610 ± 50 BP (Pta-3311).
(Dated unit: ABD II 1620 ± 50 BP (Pta-3310).

Ash above Seurat, Seurat, Lautrec, Ash below Lautrec, Ash below Dave, Ash below Dave I (ABD I), Ash below Dave II (ABD II), Shell lens in ash below Dave II, Turner, Matisse, Jeff, Blind Boy, Alvin, KTAT.

LAYER 3B:

(Dated unit: VALIANT 1800 ± 60 BP (Pta-5616).
(Dated unit: X-Ray 1780 ± 50 BP (Pta-5615).

Wright, X-Ray, Victor, Valiant, Vulcan, Base of Vulcan, Vebee, Yankee, Doodle, Speckle, Spit 1 [squares L, F, G, C, H], Spit2 [squares L, F, G, H], Spit 3 [squares L, F, G, J, H], Spit 3B [squares L, G], Spit 4 [square I].

PRE-POTTERY LAYERS:

LAYER 4:

Loose Midden, Sob.

LAYER 5A:

(Dated unit: UM2 3560 ± 60 BP corrected shell date to 3160 ± 60 BP (Pta-5498).

Upper Midden (UM) 1 to 9 [Square AA2], Spit 1 to 5 [Square AA only].

LAYER 5B:

Upper SSL, Lower SSL (Sloping Shell Lens) [Square AA2 only - it is not possible to separate finds from AAQ Spits 1 to 5 into Layer 5A and 5B].

LAYER 5C:

(Dated unit: REBEL 3810 ± 60 BP corrected shell date 3410 ± 60 BP (Pta-5662).

Rebel, Base of Rebel, Spit 1 [squares A, B, D, M, N, O, P, Q], for the moment also Toppers and Base of Toppers.

LAYER 6:

(Dated unit: SM2 3520 ± 60 BP (Pta-3604).

Shelly Midden (SM) 1 to 9 [square AA2], Shell over Ash, Wasp[square AA2], Spits 6 to 12 [square AA].

LAYER 7:

Lower Midden (LM) 1 to 8 [square AA2], Spit 13 to 18 [square AA only].

LAYER 8:

(Dated unit: FU3/4; 4020 ± 60 BP (Pta-3595).

High, Final Unit (FU) 1 to 5 [squares AA2], Cleanings on Hash, Spit 19 to 27 [squares AA].

LAYER 9: Layer 9 does not exist any more because it was wrongly dated and placed in its proper chronological order.

LAYER 10:

(Dated unit: 4190 ± 60 BP (Pta-3608).

Melanie, Grey Talus, GT, Lower GT, Slim, Drizzle, Pelmel, Shell lens in Melanie, Final Cleanings [squares S1, S2], Fubar, Scar, Burial pit infill [square M], Spit 2 [squares N, O, P, A, E], Spit 3 [squares N, O, E].

LAYER 11A:

FBL I, FBL II, Spit 2[squares M, B, C, Q].

LAYER 11B:

FBL III, FBL IV, FBS, Spit 3 [squares M, B, C, D, Q, A, P], Spit 3B [squares C, F, J].

LAYER 12: Does not exist any more.

LAYER 13A:

(Dated unit: DELTA 4330 ± 50 BP (Pta-3605).

Charlie, Ceri, Kerry, Delta, Grey Ash Shell Patch 1 (GASH 1), Gash 2, Spit 4 [except in square L].

HIATUS OF ABOUT 3000 YEARS

LAYER 13B:

(Dated unit: ECHO 7310 ± 80 BP corrected shell date to 6910 ± 80 BP (Pta-5479).

Echo, Gash 3, Fido, Cough, Gasp, Cleanings under Fido, Spit 5.

LAYER 14:

(Dated unit: HOME: 8100 ± 70 BP corrected shell date to 7700 ± 70 BP (Pta-3596).

Glow, Hard Ashy Shell Patch (HASP), Gandalf, Home, On Bedrock (OBR), Soil below Home (SBH), Amongst Rocks, Spit 6.

APPENDIX B

THE ESTABLISHMENT AND USE OF A COMPARATIVE COLLECTION

In 1965 Ray Inskeep, then head of the Department of Archaeology at the University of Cape Town, realized the need for someone to study the fish remains found in association with other faunal materials in coastal sites in South Africa. During the excavations of NBC on the Robberg peninsula at Plettenberg Bay, he suggested that I undertook the task of starting a comparative collection of modern fishes to help identify the vast quantities of fish recovered from the cave. I started by collecting as many fishes from Plettenberg Bay as I could, concentrating mainly on shallow water species excluding deep sea fishes. This strategy ensured immediately a useful collection which helped to identify fish species commonly found in south and south east coast archaeological sites. From this collection, the distinctive characteristics of certain bones were noted and used to identify the usually fragmentary archaeological remains.

The initial purpose of the project was to identify species taken by prehistoric hunter fishers and to calculate the Minimum Number of Individuals (MNI) represented. To this end I have found that the premaxilla and dentary bones due to thier robustness to be the most reliable for species identifications. I have discovered, however, that in some species other body parts were better represented, and that individual counts should be based upon whatever bone is most numerous in the samples. Of the axial skeleton the atlas and ultimate vertebra have also been used to establish MNI counts (Poggenpoel 1984).

As the research focus in the Department shifted during the early seventies towards sites along the Atlantic coast with Parkington's research at Elands Bay, the comparative sample had to be increased to accommodate estuarine

species as well as those that prefer the colder waters of the Benguela upwelling region. This work broadened the scope of my research focus since questions concerning seasonality of site occupation and changes in climatic and environmental conditions during the late Pleistocene and Holocene began to be addressed by numerous researchers. This led me to concentrate on species with particular behavioural patterns that may indicate the use of particular habitats or seasons.

APP. B.1: Fish bone analysis

Since the local environment at Elands Bay included a large body of freshwater, the Verlorenvlei, it was felt necessary that a comparative collection of fish skeletons from both estuarine and marine environments should be collected. During the first stages of the analysis it was obvious that approximately 90% of the fish recovered from archaeological sites in the vicinity of Elands Bay were species that entered estuaries as juveniles and only left the estuary when they have reached adulthood.
In order to investigate the question of the estuary having been used as a fishing habitat during prehistoric times, it was decided to select four of the most common species in the fish samples excavated to enable us to make various inferences about the fish assemblages. The selected species were flathead mullet *Mugil cephalus,* sothern mullet (harder) *Liza richardsoni,* white stumpnose *Rhabdosargus globiceps* and white steenbras *Lithognathus lithognathus*.

APP.B.:2 Southern Mullets *Liza richardsoni* (Smith 1953).
and **Flathead Mullets**. *Mugil cephalus* (Linnaeus 1758.

During the monitoring of the fish populations at Verlorenvlei it was discovered that only two species of mullets are still present in the vlei today, that is the southern mullet and flathead mullet (Grindley & Grindley 1987; pers. obs.) The skeletal parts of these species are identical and almost impossible to separate, but additional research by Wallace (1975) suggests that a useful difference exists between the maximum sizes reached by the two species in estuarine environments. Both species leave the estuarine environments when they become sexually mature, southern mullet

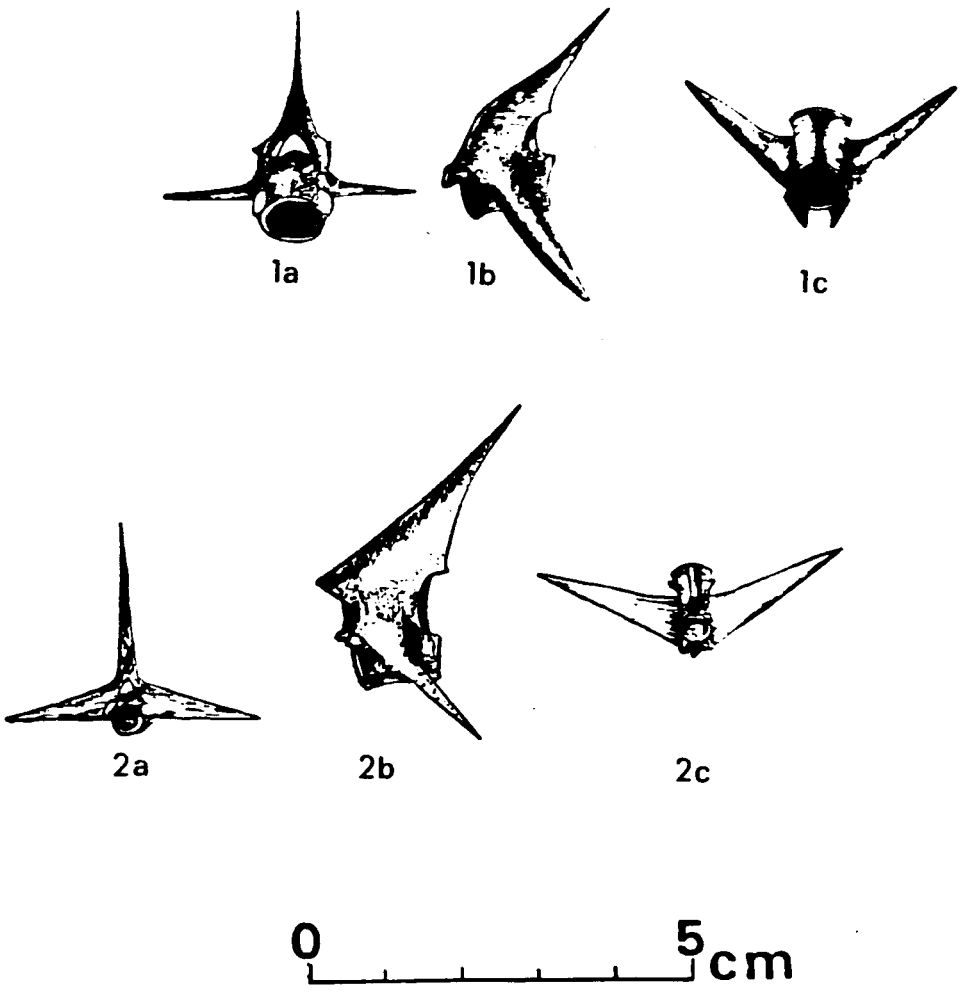
when they reach a size of 200 mm and flathead mullet when they are 430 mm in length (Wallace 1975). The maximum size that the two species reach is 400 mm and 750 mm respectively.

In all the fish samples so far examined the mandibular bones of mullet fish have always been under represented. This situation prompted me to look for other body parts that would be more representative of the mullet in the samples. A number of mullet skulls were selected to be crushed in order to determine which parts would survive best in a fragmentary state. The results showed that the jaw bones disintegrated quickly, but the basi-occipital bone and atlas survived well. It was also found to be distinct enough to provide reliable identifications (Poggenpoel 1984). By using the basi-occipital and atlas bones to identify mullets, the mullet MNIs for many sites has been increased, and on the basis of size the two species have been separated.

More recently I have rexamined the mullet bones under a low powered microscope and discovered that it is possible to distinguish atlas and basi-occipital bones of southern mullet from those of the flathead mullet. Although the bones are very similar in structure some differences were noted (App.B: Figure 1). In the case of the basi-occipitals, the southern mullet bone differs from the flathead mullet by having two projecting processes along its lateral sides whereas the flathead mullet bone has none. Similarly the atlas vertebra of the southern mullet has two ridges and a central cavity along its ventral side, whilst the atlas of the flathead mullet has only one ridge and no cavity. On the basis of these distinctions it has now become possible to differentiate between the two species in prehistoric fish samples, and this method is more reliable then the previous one, because all sizes of each species can now be separated.

APP.B.3: White stumpnose *Rhabdosargus globiceps*

The white stumpnose from EBC are larger then the modern samples collected from the Klein River, Diep River and Brede River estuaries (Talbot 1955; Millard *et al.* 1953; Millard & Scott 1954).



App.B: Figure 1. 1a dorsal aspect, 1b lateral aspect and ventral aspect of a flathead mullet *Mugil cephalus* basi-occipital, 2a dorsal aspect, 2b lateral aspect and ventral apects of a southern mullet *Liza richardsoni* basi-occipital.

Observations at Milnerton and Diep River estuaries indicate that juvenile white stumpnose in these estuaries range in size from about 6 mm to about 154 mm.

According to Talbot (1951), who studied the white stumpnose at the Klein River estuary, spawning takes place when the fish has reached a size of approximately 240 mm in length, although a marked increase in gonad weight is already seen at 220 mm in females, whilst the males mature at approximately 275 mm. By comparing the Elands Bay white stumpnose to those of estuarine and marine samples taken from various points along the south coast, the archaeological sample from the cave site show that only a small proportion of fish falls inside the estuarine range. The largest stumpnose taken from the estuaries is 154 mm, whereas the smallest in the EBC sample is 150 mm.

The white stumpnose that lives in the marine environment leaves the shallows just before dawn and moves to deeper waters during the day. This behaviour of feeding in the shallows at night and moving to deeper waters by day, may be explained as the avoidence of long periods of bright sunlight (Biden 1954). Fish taken during the months of January and February have shown signs of white spots and blotches on the eyes, which maybe the result of excessive strong sunlight exposure. In search of constant cool temperatures and to avoid the stronger rays of the approaching summers sun, the white stumpnose moves off to deeper waters during mid October, hence the disappearance of the fish from coastal areas during the onset of summer.

The white stumpnose are caught throughout the year in False Bay, though always in greater numbers when cold currents appear. During and after the month of May they are found in great abundance, often until the beginning of October. Large shoals are found in the shallows at night, when they come inshore in less then 1.5 m of water, feeding during calm conditions. Many anglers have fished for white stumpnose from the Kalk Bay pier in the evenings and large numbers have been taken with trek nets at the Strand, Muizenberg, Fish Hoek, Simonstown and Hout Bay (Biden 1954; A. Poggenpoel pers. comm.).

APP.B.4: White steenbras *Lithognathus lithognathus* (Cuvier 1830).

The white steenbras is regarded as a winter fish, and its migration pattern seems to be the same as that of the white stumpnose. They have a strong tendency to frequent the same habitats on a yearly basis and because of this behaviour a seasonal pattern can be followed. They frequent shallow water and freely enter estuaries and lagoons where they are able to tolerate almost fresh water conditions for extended periods of time. White steenbras do not always take live bait from lines and could be considered a difficult fish to catch with hand lines. Large numbers have been caught by trek fisherman around the coast with trek nets and information on migration is best taken from where and at what period through the year the fish have been most abundant.

Those that enter estuaries are generally sexually inactive and leave the confines of the estuary when they reach sexual maturity. Marine specimens are known to spawn from June to August and sexual maturity is attained after approximately five years corresponding to a fish length of 320 mm. During the monitoring of the steenbras at the Heuningnes estuary with John Mehl, sub adults were caught with handlines some five kilometres from the estuary mouth (Mehl 1973; pers. obs.). This would imply that older steenbras tend to move further upstream away from the mouth of the estuary, possibly because the development of their osmoregulatory system allows them to cope with lower water salinities. Fish lengths have been determined by measuring the length of the premaxillae and using the correlation between that and the fork lengths. 114 modern specimens have been collected from the Heuningnes estuary near Bredarsdorp and the measurements showed that a good relationship exists between premaxilla length and body length. All of the steenbras monitored at the Heuningnes estuary showed a normal shift in population size over a one year period and none of them seems to have reached an age older then six years whilst living in the confines of the estuary (App.B: Figure 2) (Mehl 1973).

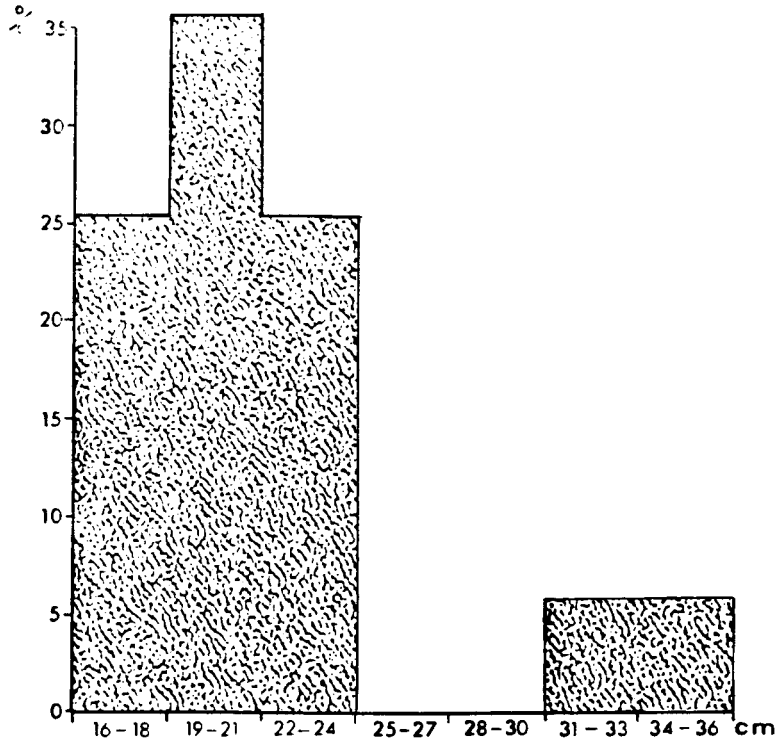
The estuary is open to the sea at all times, and the openess of the estuary would ensure that a constant influx of fry would replenish the stocks as mature fish leave the environs of the estuary. Since spawning takes place during the winter months at sea, all steenbras that use estuaries as nursery grounds start to leave the confines of the estuary to spawn before the onset of winter.

white steenbras *Lithognathus lithognathus*

Estuarine Sample

n = 62

mean length = 20.5 cm



Fork length in 3 cm classes

App. B. Figure 2. A sample of white steenbras *Lithognathus lithognathus* taken from the Heuningnes estuary near Bredarsdorp with John Mehl in 1973. The group that range between 16 - 24 cm was caught at the estuary mouth and the group that range from 32 - 36 was caught five kilometers upstream.

As the water table in the estuary rises with the first good rains, the fish leave with the stronger outflow of water. Fishermen that understand the behaviour of estuarine species may enhance their catches by utilizing the mouths of estuaries at certain times of the year. When this practice has been adhered to, the fish captured will be dominated by fishes which have reached sexual maturity and have grown to a size ready to leave the estuarine environment.

APP.B:5 Fish internal skeleton

The only bony parts of fish which are likely to be preserved in archaeological deposits are some skull bones, vertebrae and spines. From the skull bones that survive the most reliable for species identification are the premaxillae and dentaries, although other body parts have been used in cases when mandible bones are low for MNI counts. From my experience the most common fish bone to survive are the vertebrae.

The vertebral column is composed of distinct bony vertebra, each of which has concave ends and is constricted in the centre. On the dorsal side of the vertebra there is a pair of processes that unite to form the neural arch. In the trunk region each vertebra bears a pair of ventrolateral processes to which the ventral ribs are attached. Lower in the tail region these processes are bent downwards and unite to form the haemal arch. The main function of the vertebral column is to give support to the body and provide a cavity for the viscera ribs in the abdominal region to provide attachments for the mussels of the body.

When vertebrae are found in archaeological deposits, in many cases the ventral and dorsal processes are broken off, which makes separation of vertebrae into heamal, neural and thoracic rather difficult. Other vertebra such as the atlas and ultimate vertebra can be used to help establish MNI counts and the diameter measurements have help to establish the size of fishes caught prehistorically.

Below is a description of a number of cranial bones which have been identified in the fish bone assemblages examined in this thesis.

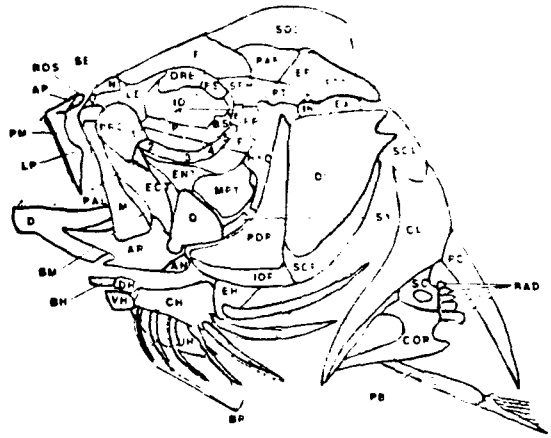
APP.B.6: The Skull (App.B Figure:3)

The supraoccipital is the most posterior bone on the dorsal surface of the head, it rises above the roof of the neurocranium. In some fishes the frontal brakes into two halves and in others becomes heavily ossified (e.g. family Sparidae). The jaw bones are the most distinctive and are widely used by ichthyoarchaeologists to identify different species. They are made up of three pairs of bones, the maxilla, premaxilla and dentaries. In many fishes the maxilla carries no teeth, whereas the premaxilla and dentaries has rows of teeth. The white stumpnose *Rhabdosargus globiceps* and white musselcracker *Sparadon durbanensis* have been seperated on the placement of the incisor teeth (Appen. B Figure 4).

The upper and lower pharangeal bones which is associated with the pharangeal bronchials also have rows of teeth and are highly specialized in some bony fishes. They are sometimes referred to as supra and infra pharangeal plates, these survive well in archaeological deposits and can be useful in confirming species identifications.

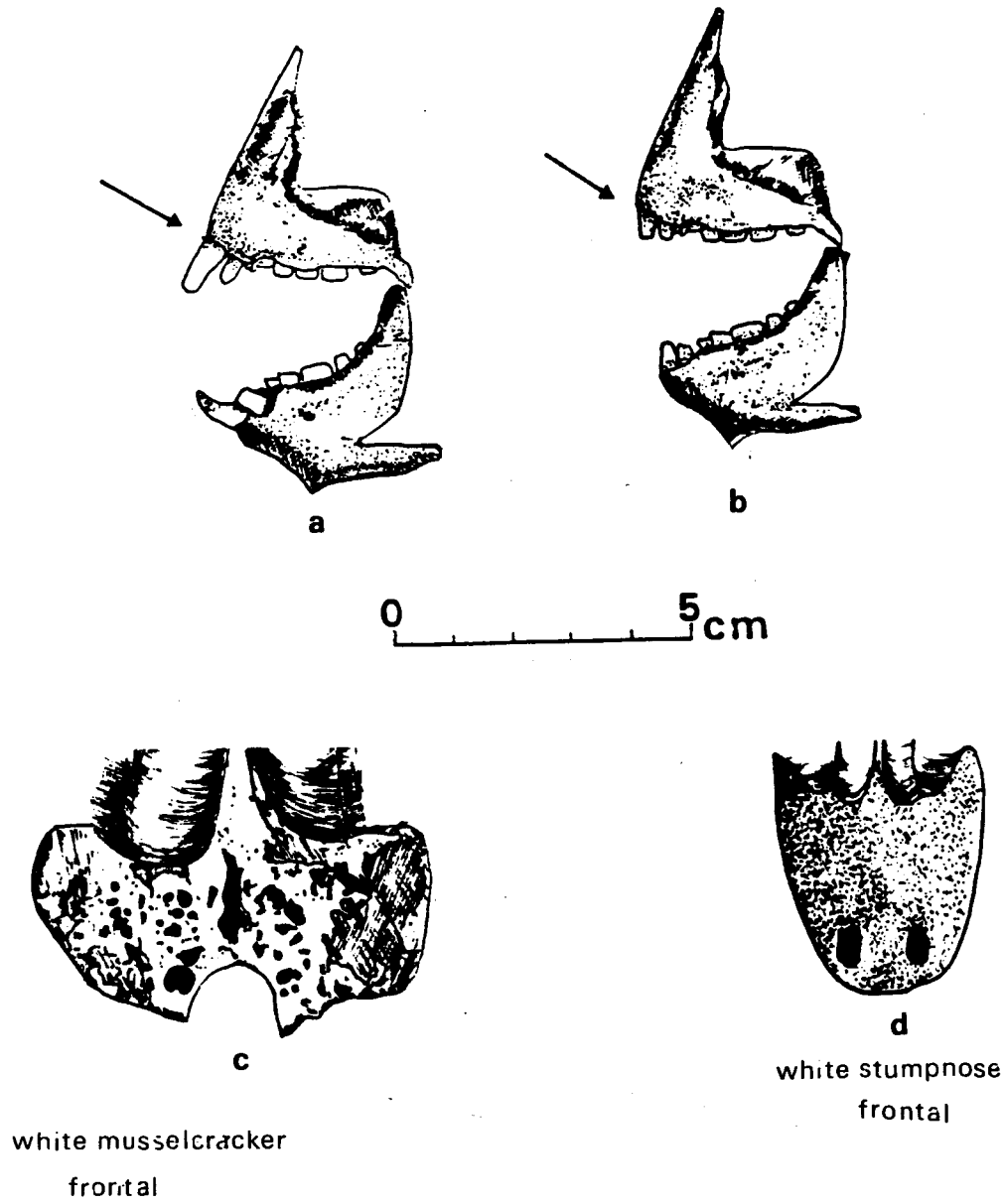
The articular is an extension of the lower mandible and articulate with the quadrate which is fastened to the symplectic and hayomandibular. The hayomandibular articulates with the opercular which is the largest of four bones that protects the gills. The bottom edge is normally hidden beneath the preopercular which is much thinner and stronger than the opercular. There is a distinct notch in the front edge of the preopercular which fits around a large knob on the interopercular. This bone lies below the preopercular with the subopercular that fits along the rear edge of the opercular.

The bronchial skeleton is made up by a series of fragile paired bones. These bones support the gill rakers. The ceratohyal is the largest and is attached anteriorly by the hypohyal and posteriorly by the epihyal (App. B Figure 5).

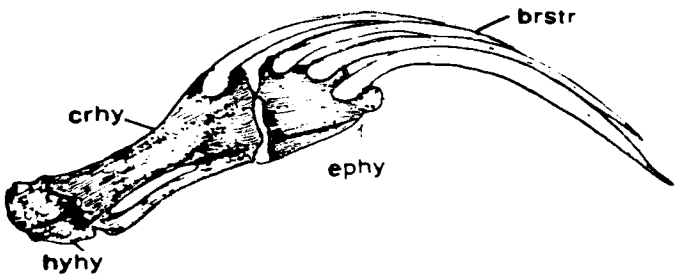


AN angular
AP ascending process of premaxila
BA basioccipital
BH basihyal
BR branchiostegal rays
BS basisphenoid
CER ceratohyal
CL cleithrum
COR coracoid
D dentary
DH dorsal hypohyal
ECT ectopterygoid
EH epihyal
ENT entopterygoid
EP epioccipital
Ex exoccipital
F frontal
HYO hyomandibula
IN intercalar
IO infraorbitals (1-6)
IOP interopercle
LE lateral ethmoid
LP lateral process of premaxilla
M maxilla
MPT metapterygoid
N nasal
ORB orbitosphenoid
P parasphenoid
PAL palatine
PAR parietal
PB pelvic bone
PC postcleithrum
PM premaxilla
POP preopercle
PRO preorbital
PR prootic
PS pterosphenoid
PT pterotic
PTT posttemporal
Q quadrate
RAD radial
ROS rostral cartilage
SC scapula
SCL supracleithrum
SE supraethmoid
SM supramaxilla
SOC supraoccipital
SOP suboperele
SHP spenotic
SY symplectic
UH urohyal
V vomer
VH ventral hypohyal

App.B Figure 3. a) The lateral aspect of a fish cranium with the positioning of the different cranial elements. b) shows the cranial elements most often recovered in archaeological fish assemblages.



App.B: Figure 4. a) The premaxilla and dentary of white musselcracker *Sparadon durbanensis*. b) The premaxilla and dentary of white stumpnose *Rhabdosargus globiceps*. Note the positioning of the incisors.



App. B. Figure 5. Outer bronchail skeleton - left side (gill arches not shown) of yellow tail *Seriola lalandii*

brstr branchiostegal rays hyhy hypohyal

crhy ceratohyal ephy epihyal

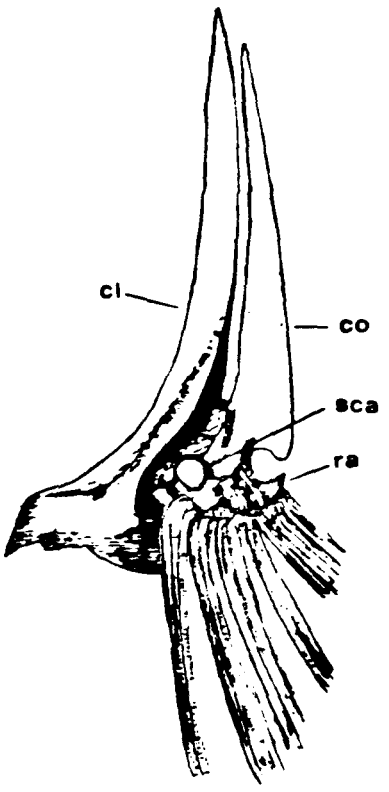
On the dorsal surface of the epihyal the interhyal is a small bone sometimes triangular in shape found in the throat region, which are very distinct and can be used for MNI counts as well as species identifications (Kusaka 1974). The ceatohyal, epihyal and urohyal are the most robust in the hyoid arch and are more often found with bronchiostegal rays in archaeological samples.

There are three pterygoid bones of which the entopterygoid is the most useful and can be used to indicate size as well as identify species (Poggenpoel, 1984). The parasphenoid is a thin slender bone which is attached to the prethmoids which are covered by the vomer anteriorly. It is also attached to the large basioccipital posteriorly. Above the basioccipital the basisphenoid forms part of the base of the cranium and together with the parasphenoid runs between and below the eyes as a narrow ridge. The basioccipital which forms the lower edge of the neurocranium has a articulating surface for the attachment to the first vertebra.

APP.B.:7 The Pectorial and Pelvic Skeleton (App.B Figure:6).

Almost all vertebrate fishes have two pairs of pectoral fins which are placed behind the skull. The shoulder girdle is part of a functional unit of the skull and supports the pectoral fins. The actual fin is supported on a series of small radials which intern articulates with the scapula and coracoid. Both these bones are attached to the larger cleithrum which has a hollow underside. A small elongated bone called the supra-cleithrum is attached with firmly linked ligaments to the dorsal surface of the cleithrum. A long slender post-cleithrum is attached internally to the cleithrum and extends ventrally. The posttempral is fastened to the back of the skull.

Although there are many other bones in the cranium, the bones discribed above have been recovered more often and seems to survive best in the archaeological record. From the analysis of fish bones from a number of sites, it was discovered that fish body parts survive differently in open and cave sites.



App. B. Figure 6. Pectorial and pelvic skeleton of a yellowtail *Seriola lalandii*

cl cleithrum sca scapula

co coracoid ra radials

APPENDIX C

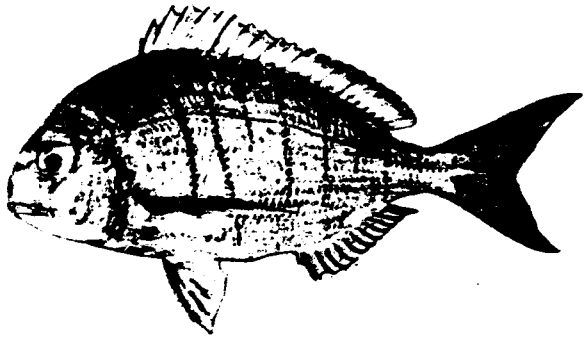
Appendix C represents a number of fish species commonly found associated in archaeological sites in the southwestern Cape. Notes have been compiled from various sources ie. from Robertson & Dunn, 1923; Biden, 1930; Smith, 1953; Smith & Smith, 1966; Day, 1969; Smith, 1975; Branch & Branch, 1981; van der Elst, 1981; Branch *et al.*, 1993.

Rhabosargus globiceps (Cuvier 1830).

Family SPARIDAE. Sub - family SPARINAE :

Common name : S.A. White stumpnose

Chrysophrys globiceps Cuvier, in Cuv. & Val. 1830: 100 (Cape of Good Hope). *Sagus natalensis* Steindachner, 1861: 180 (Durban). *Sargus nigrofasciatus* Regan. 1908: 253, Pl. 41 (Natal) *Austrosparus globiceps* : Smith, 1938 :243. *Rhabdosagus globiceps* : Smith, SFSA No. 708 ; Smith and Smith, 1966 : 47.; Smith, 1979: 704; van der Elst, 1981 : 332.

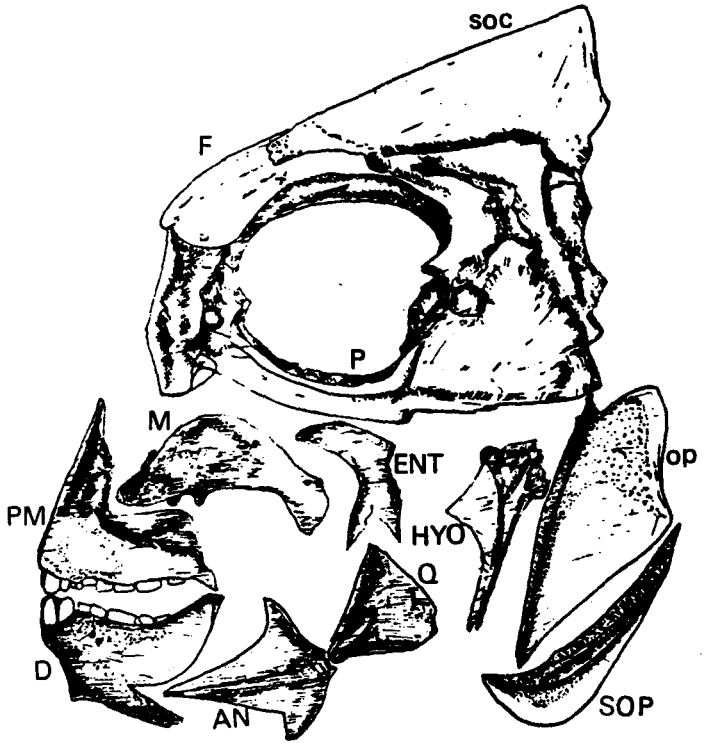


In the upper jaw there are 4-6 compressed teeth and 4-8 in the lower. Fairly powerful rounded or oval molars in each jaw. Although the

mandibles of the white stumpnose looks similar in structure to that of the white biskop *Sparadon durbanensis*, the teeth are different. In the case of the white stumpnose its frontal teeth are short rounded even and teeth, whereas the white biskop's frontal teeth are conspicuous with two long and powerful `incisors' set together in front of both upper and lower jaws. Stumpnose prefer sandy areas, juveniles enter estuaries, but adults rarely do so. Spawning takes place during spring and summer.

Distribution

Found only from Angola to Natal down to 100m, most abundant at the Cape, taken in large numbers by net and line close inshore at night.

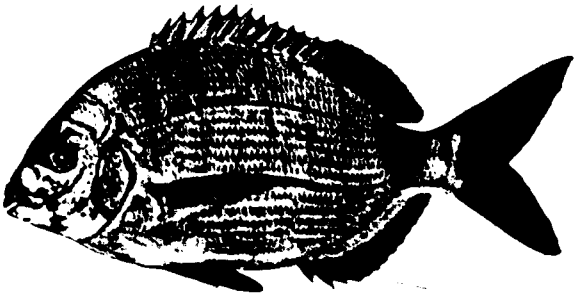


Diplodus sargus capensis (Linnaeus, 1758).

Family SPARIDAE. Sub-family SPARINAE :

Common Name ; Black tail, Dassie.

Sargus capensis : Smith, 1844: Pl. 23, Fig. 2 (South Africa). *Diplodus rondeleti var capensis* : Barnard, 1927: 691. *Diplodus sargus* : Smith, 1938: 253; SFSA No. 713; Smith and Smith, 1966: 40; van der Elst, 1981: 316. *Diplodus sargus capensis* : Smith, 1981:180.

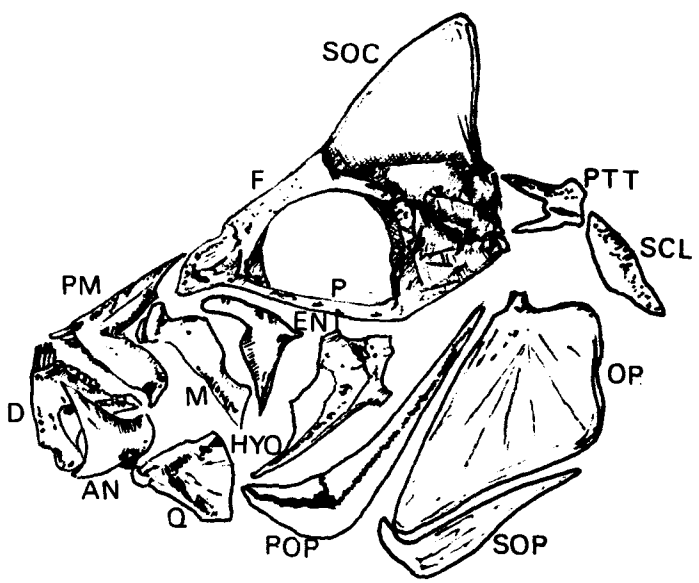


Diplodus is the generic name used in classifications of some sparids having as one of the principal characteristics, two forms of teeth, ie. a single series of slightly protruding chisel edge 'incisors' and three to four series of small 'molars' in the upper, and two to three in the lower jaw. The

blacktail is primarily an inshore species, favouring turbulent seas and rocky shores. It moves in and out of this zone with the tides, and it also often occurs in small shoals over the outer edges of deeper reefs and around offshore pinnacles. It cannot tolerate a wide range of temperatures, and enters estuaries, but are rarely found in low salinity regions, it has also been reported by Biden (1954) that they do enter tidal rivers along the south coast. The blacktail occurs throughout the year, but is most common along the east coast from April to September. Sexual maturity is attained at a length of about 16 cm and spawning occurs all year round, but especially during mid summer and early spring. Attains 45 cm.

Distribution

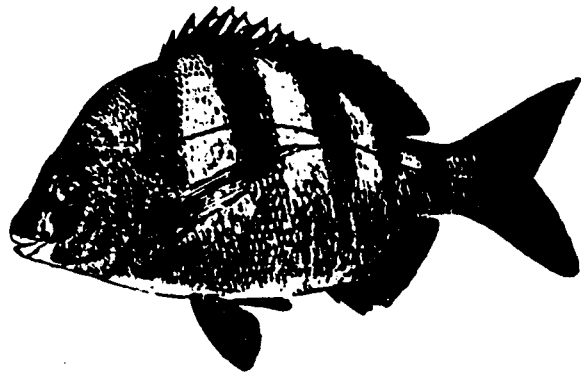
From Angola to Mozambique and southern Madagascar and possibly reaches Mauritius.



Diplodus cervinus hottentotus (Smith, 1844).

Common name : Zebra

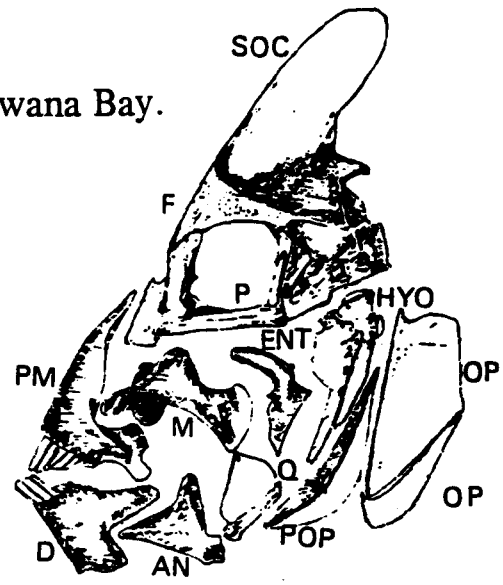
Sargus hottentotus Smith, 1844, Pl. 23, Fig. 1 (South Africa). *Diplodus trifasciatus* : Smith, 1938 :254; SFSA No. 714; Smith & Smith, 1966:41. *Diplodus cervinus* : Bauchot & Daget, 1971 : 322; Smith, 1075: 53; van der Elst, 1981:315. *Diplodus cervinus hottentotus* : Smith, 1981 : 180.



This species spawns along the south coast during summer. Its distribution is from the Cape to Sodwana Bay in waters which are up to 60m deep. It grows to approximately 60 cm when caught and landed it emits a powerful nauseating odour. It behaves very much the same as the *Diplodus sargus capensis* but even more difficult to hook.

Distribution

From the Cape to Sodwana Bay.



Distribution

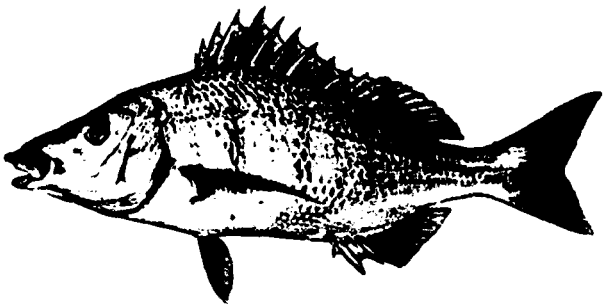
From the Cape to Sodwana Bay.

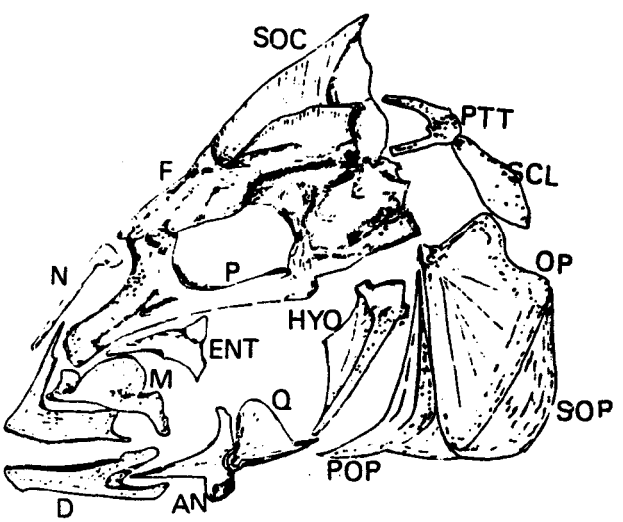
Lithognathus lithognathus (Cuvier 1830).

Family SPARIDAE. Sub - family PAGELLINAE:

Common name : S.A. White steenbras.

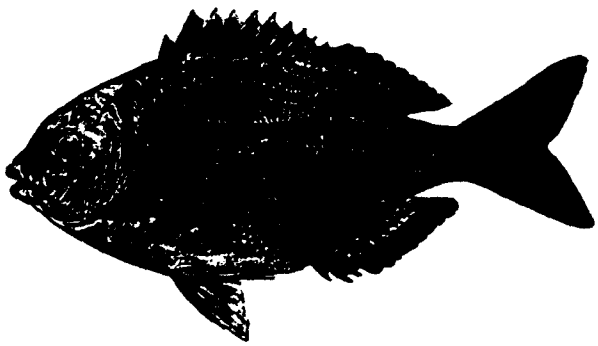
Pagellus lithognathus Cuvier, in Cuv. & Val., 1830: 204, Pl. 151 (Cape of Good Hope). *Lithognathus capensis* Swan-song, 1839: 222 (on Cuvier, 1830). *Lithognathus lithognathus* : Smith, 1938: 277; SFSA No. 726; Smith, 1962: 111; Smith & Smith, 1966: 65; van der Elst, 1981: 318.

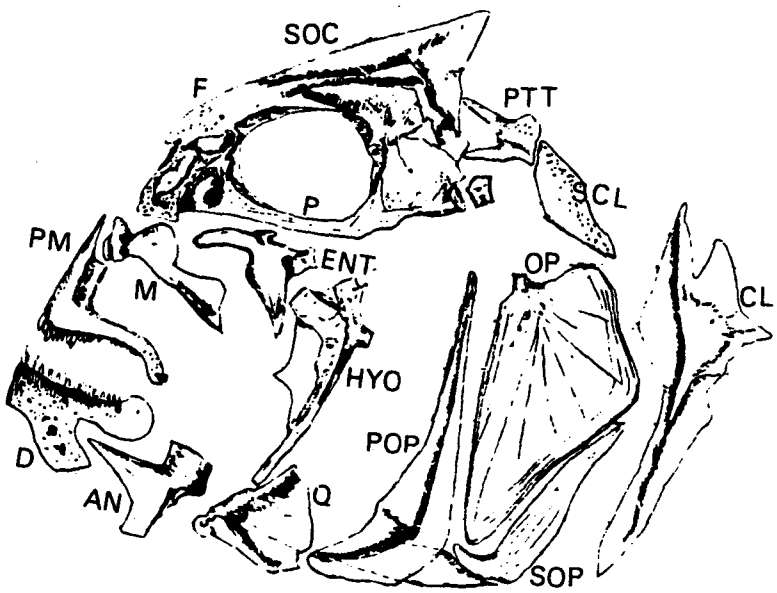




The white steenbras has very small teeth compared with the white stumpnose. The teeth are in bands, slightly pointed with two series of small molars in the upper and lower jaws. Enters lagoons and estuaries freely, large individuals penetrate into shallow water, prefers sandy areas, juveniles use estuaries as nurseries although adults spawn at sea from June to August.

Pachymetopon blochii (Valenciennes 1830)
Common name : Hottentot
Cantharus Blochii Valenciennes, in Cuv. & Val., 1830: 339 (Cape of Good Hope). *Cantharus castelnau* Bleeker, 1860: 59 (Cape of Good Hope). *Pachymetopon Blochii*: Smith, 1938: 285;SFSA No.36: van der Elst, 1981: 321. *Pachymetopon canescens* Norman, 1935: 14, Pl.2 (False Bay).



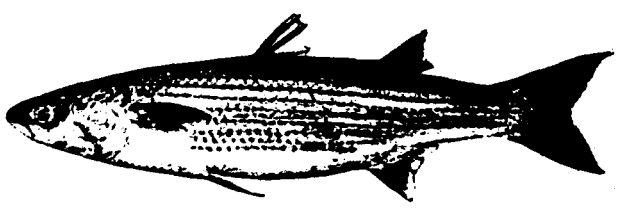


A common food fish of the Cape, taken in fairly large numbers from deepish rocky areas with Kelp beds. attains 46 cm Distribution from west coast of South Africa north to Angola, rarely east of Cape Agulhas. Does not enter estuaries.

MUGILIDAE

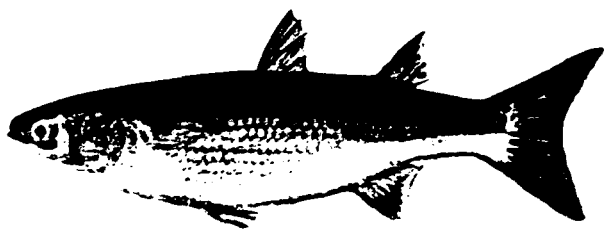
There are thirteen genera containing about 70 species accepted at present (with 32 more of doubtful status); 5 genera and 15 species recorded from South Africa. They are circum global fishes of commercial importance, found in all but the coldest seas near the coast, and in estuaries. Two of our species migrate up rivers, and our endemic fresh water mullet return to the sea only to spawn. All species spawn offshore, mainly in winter or spring; the young enter estuaries at about 10-15 mm and only return to the sea when they have reached adulthood.

Liza richardsoni (Smith, 1846)
Common name: Southern mullet
Mugil richardsoni Smith, 1846: Pl.29, Fig. 1 (South Africa Cape). *Liza ramada* (non Risso): Smith, 1965 SFSA No. 887. *Mugil richardsoni*: Smith, 1965: 22; Smith & Smith, 1966: 101; Wallace & van der Elst, 1975: 14; van der Elst & Wallace, 1976: 373; van der Elst, 1981: 217.

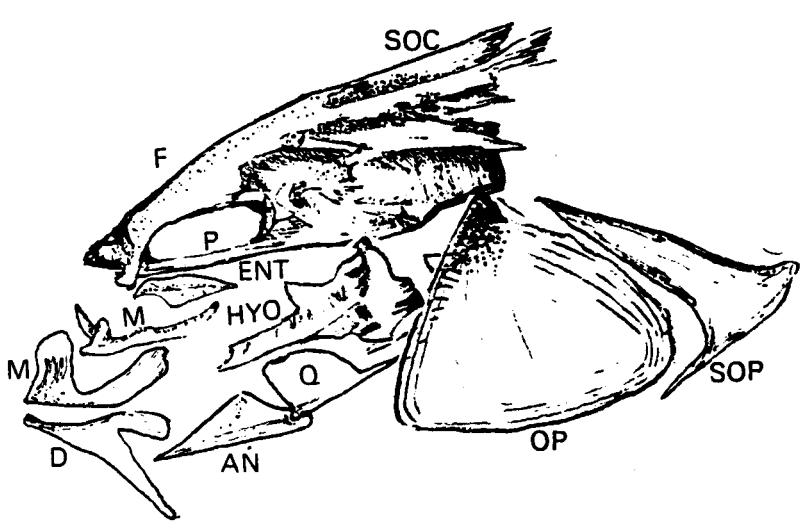


Mugil cephalus (Linnaeus 1758).
Common name Flathead mullet

Mugil cephalus Linnaeus, 1758:316 (European seas); Smith, SFSA No. 877; Smith & Smith, 1966: 100; van der Elst & Wallace, 1976: 372; van der Elst, 1981: 219. *Myxus barnardi* Gilchrist & Thompson, 1914: 83 (Durban Bay).



Attains 60 cm found in all warm and temperate seas, estuaries, lagoons and rivers, It is tolerant of fresh water.



BIBLIOGRAPHY

Allanson, B.R. 1984. Symposium on the Benguela 'warm event' of 1982-1983: The Symposium in Retrospect. South African Journal of Science **80**:(2)50-1.

Alexander, J.E. 1838. Expedition of Discovery into the Interior of Africa. London.

Anderson, G.C. 1991. Andriesgrond revisited: Material culture, ideologies and social change. Unpublished B.A.(Hons) thesis, University of Cape Town.

Atkins, G.R. 1970. Thermal structure and salinity of False Bay. Transactions of the Royal Society of South Africa **39** (2):117-128

Avery, D.M. 1982. Micromammals as paleoenvironmental indicators and an interpretation of the Late Quaternary in southern Cape Province, South Africa. Annals of the South African Museum **85**:183-374.

Avery, G. 1975. Discussion on the age and use of tidal fish traps (visvywers). South African Archaeological Bulletin **30**:105-113.

Avery, G. 1977. Report on the marine bird remains from the Paternoster midden. South African Archaeological Bulletin **32**:74-76.

Avery, G. 1987. Coastal Birds and Prehistory in the western Cape. J. Parkington and M. Hall, (eds). In Papers in the Prehistory of the Western Cape, South Africa. pp.164-190, British Archaeological Reports International Series **332** (1). Oxford: British Archaeological Reports.

Avery, G. 1990. Avian fauna, palaeoenvironments and palaeoecology in the late Quaternary of the western Cape, South Africa. Unpublished Ph.D thesis, University of Cape Town.

Avery, G., Cruz-Uribe, K., Goldberg, P., Grine, F.E., Klein, R.G., Lenardi, M.J., Marean, C.W., Rink, W.J., Schwarcz, H.P., Thackeray, A.I. & Wilson, M.L. 1995. The 1992-93 Excavations at the Die Kelders Middle and Later Stone Age Cave site, South Africa. Submitted to the Journal of Field Archaeology.

Bailey, G. & Parkington, J. 1988. The Archaeology of Prehistoric Coastlines. Cambridge University Press Cambrige.

Barrow, J. 1801. An account of travels into the interior of Southern Africa in the years 1797 and 1798. London: Cadell & Davies.

Barrow, J. 1806. Travels into the interior of Southern Africa. London: Cadell & Davies

Berger, L. & Parkington, J. 1996. A new Pleistocene hominid bearing locality at Hoedjiespunt South Africa. American Journal of Physical Anthropology 98:601-9.

Biden, L. 1954. Sea angling fishes of the Cape (South Africa). Cape Town: Juta.

Binford, L.R. 1984. Faunal Remains from Klasies River Mouth. New York: Academic Press.

Binneman in Prep. Excavations of the Kabeljous rivier Rock Shelter.

Birch, G.F., Day, R.W. & Du Plessis, A. 1991. Nearshore Quaternary sediments on the west coast of South Africa. Department of mineral and energy affairs. Geological survey Bulletin 101.

Böeseken, A.J. (ed). 1961. Resoluties van die Politieke Raad, Deel iii.... Suid Afrikaanse Argiefstukke, Kaap No. iii. Cape Town: Nasionale Handelsdrukkery BPK.

Branch, G. & Branch, M. 1981. The Living Shores of Southern Africa. Cape Town: Struik.

Branch, G.M., Puttick, G.M., Moldan, A. & Christie, D.N. 1976. Studies of the inter-tidal and sub-tidal fauna of the Saldanha region.

British Archaeological Reports International Series **406**. Oxford: British Archaeological Reports.

Casteel, R.W. 1976. Fish Remians in Archaeology and Paleo-environmental studies. New York: Academic Press.

Clark, J.D. 1959. The Prehistory of Southern Africa. Harmondsworth: Penguin.

Clason, A.T. 1986. Fish and Archaeology, In Brinkhuizen, D.C. & Clason, A.T. (eds). Fish and archaeology, pp. 1-8. British Archaeological Reports International Series, No **294**. Oxford: British Archaeological Reports.

Cohen, A.L. 1993. A Holocene surface temperature record in mollusc shells from the South African coast. Unpublished Ph.D Thesis, University of Cape Town.

Cohen, A.L., Parkington, J.E., Brundrit, G.B. & van der Merwe, N.J. 1992. A Holocene sea surface temperature record in mollusc shell from the south-west African coast. Quaternary Research **38**:379-385.

Cram, D.L. 1970. A suggested origin for the cold surface water in central False Bay. Transactions of the Royal Society of South Africa **39** (2):129-137.

Cruz-Uribe, K. & Schrire, C. 1991 Analysis of faunal remains from Oudepost 1, an early outpost of the Dutch East India Company, Cape Province. South African Archaeological Bulletin 46:92-106.

Dannevig, A. 1955. Chemical composition of the zone in cod otoliths. Journal of Conservation perm. International Exploration Meritime. **21**:156-9. 160.

Day, J.H. 1959. The biology of the Langebaan Lagoon: a study of the effect of shelter from wave action. Transactions of the Royal Society of South Africa **35**:476-547.

Day, J.H. 1969. A Guide to Marine Life on South African Shores. Cape Town: Balkema.

Day, J.H. 1980. What is an Estuary? Reply. South African Journal of Science **76**: 341.

Deacon, H.J. 1969. Melkhoutboom Cave, Alexandria District, Cape Province: A report on the 1967 investigation. Annals of the Cape Provincial Museums **6**:141-69.

Deacon, H.J. 1970. Two shell midden occurrences in the Tsitsikama National Park, Cape Province. Koedoe **13**:37-49.

Deacon, H.J. 1976. Where Hunters Gathered. Claremont: South African Archaeological Society Monograph Series **1**.

Deacon, H.J. & Schuurman, R. 1992. The origins of modern people: the evidence from Klasies River. In (Bräuer G. & Smith, F.H. (Eds). Community or Replacement: Controversies in *Homo sapiens* Evolution, pp. 121-129. Rotterdam: Balkema.

Deacon, J. 1984. The Later Stone Age of Southernmost Africa. Cambridge Monographs in African Archaeology **12**. British Archaeological Reports International Series **213**. Oxford: British Archaeological Reports.

Deacon, J. 1978. Holocene and Pleistocene palaeoclimates in the western Cape. In J. Parkington and M. Hall (eds). Papers in the Prehistory of the Western Cape. pp. 24-34. British Archaeological Reports International Series 332(1).

Deacon, J., & Lancaster, N. 1984. A synthesis of the evidence for climatic change in southern Africa over the last 125,000 years. Unpublished report, CSIR National programme for weather, Climate and Atmosphere Research, Pretoria.

Deacon,J., Lancaster, N. & Scott, L. 1984 Evidence for Late Quaternary climatic change in southern Africa: Summary of the proceedings of the SAQUA Workshop held in Johannesburg, September 1983. In Vogel, J.C. (ed.) Late Cainozoic palaeoclimates of the southern hemisphere pp. 391-404. Rotterdam: Balkema.

De Decker, A.H.B. 1970. Notes on an oxygen depleted subsurface current off the west coast of South Africa. Investigational Report Division of Sea Fisheries, South Africa **84**:1-24.

Flemming, B.W. 1976. Distribution of recent sediments in Saldanha Bay and Langebaan lagoon. Transactions of the Royal Society of South Africa **42**:317-340.

Flemming, B.W. 1977. Depositional processes in Saldanha Bay and Langebaan Lagoon. Stellenbosch: CSIR.

Geldenhuys, N.D. 1973. The growth of the South African marsbanker *Trachurus trachurus* and age composition of catches, 1950-71. Sea Fisheries Branch Investigational Report. No. **101**.

Gilbert, C., Sealy, J. & Sillen, A. 1994. An Investigation of Barium, Calcium and Strontium as palaeodietary indicators in the south-western Cape, South Africa. Journal of Archaeological Science **21**:173-184.

Goodwin, A.J.H. 1938a. Archaeology of Oakhurst Shelter, George. Transactions of the Royal Society of South Africa **25**:229-324.

Goodwin, A.J.H. 1938b. Klipkop Cave, Hermanus. Annals of the South African Museum **24**: 5.

Goodwin, A.J.H. 1946. Prehistoric Fishing methods in South Africa. Antiquity **20**:134-141.

Goodwin, A.J.H. 1949. A Fishing scene from Griqualand. South African Archaeological Bulletin **4**:51-3.

Goodwin, A.J.H. & van Riet Lowe, C. . 1929. The Stone Age Cultures of South Africa. Annuals of the South African Museum **27**:289.

Grindley, J.R. 1969. Riches of the Sea. Cape Town: National Commercial Printers

Grindley, J.R. 1979. Zooplankton of the estuaries and lagoonms of the west coast of southern Africa. Fourth National Oceanographic Symposium. Cape Town, South Africa.

Grindley, J.R. 1980. The hydrological environments of False Bay. The future mangement of False Bay. Proceedings of a seminar held on the 11th of June 1980 in Cape Town. Ed. B. Gasson.

Grindley, J.R. & Taylor, F.J.R. 1970. Factors affecting plankton blooms in False Bay. Transactions of the Royal Society of South Africa. **39** (2):201-210.

Grindley, J.R., Lane, S.B. & Robertson, H.N. 1982. The environment and ecology of Verlorenvlei. In Verlorenvlei: a challenge to conservation. University of Cape Town, Cape Town.

Grindley, J.R. & Grindley, S.A. 1987. The ecology and biological history of Verlorenvlei. In J.Parkington and M. Hall, (eds). Papers in the Prehistory of the Western Cape, South Africa. pp. 97-119. British Archaeological Reports International Series **332**(1). Oxford: British Archaeological Reports.

Grine, F.E., Klein, R.G. & Volman, T.P. 1991 Dating, archaeology and human fossils from the Middle Stone Age levels of Die Kelders, South Africa. Journal of Human Evolution **21**:363-395.

Grine, F.E. & Klein, R.G. 1993. Late Pleistocene human remains from the Sea Harvest site, Saldanha Bay, South Africa. South African Journal of Science **89**:145-154.

Grobbelaar, C.S. & Goodwin, A.J.H. 1952. "Report on the skeletons and implements in association with them from a cave near Bredarsdorp, Cape Province". South African Archaeological Bulletin **7**:95-101.

Groenewald, A.A. Van J. 1961. *Clarius*, The freshwater barbel. Fauna & Flora Pretoria **12**.

Hall, M., Halkett, D., Huigen vav Beek, P. & Klose, J. 1990. 'A stone wall out of the earth that thundering cannon cannot destroy'?. Bastion and moat at the Castle, Cape Town. Social Dymanics **16**(1): 22-37.

Hall, S. 1986 Pastoral adaptations and forager reactions in the eastern Cape. South African Archaeological Society, Goodwin Series **5**:42-49.

Hall, S. 1990. Hunter-Gatherer-Fishers of the Fish River Basin: A contribution to the Holocene Prehistory of the eastern Cape. Unpublished Ph.D thesis, University of Stellenbosch.

Halkett, D.J. 1991. Spatial distrbution of artefacts at Putslaagte 41: Evidence for social organisation on a late Holocene site, southwestern Cape, South Africa. Unpublished M.A. thesis, University of Cape Town.

Harrison, A.C. 1963. Freshwater Fish and Fishing in Africa. Johannesburg: Thomas Nelson & Sons.

Hendey, Q.B. & Volman, T.P. 1986. Last Interglacial sea levels and coastal caves in the Cape Province, South Africa. Quaternary Research **25**, 189-198.

Heydorn, A.E.F. & Tinley, K.L. 1980. Estuaries of the Cape. part **1**: Synnopsis of the Cape coast and natural features, dynamics and utilization. Research Report **380** CSIR Stellenbosch, South Africa.

Henshilwood, C.S. 1995. Holocene Archaeology of the Garcia State Forest, southern Cape. South Africa. Unpublished Ph.D thesis, University of Cambridge, England.

Henshilwood, C., Nilssen, P. & Parkington, J. 1994. Mussel drying and food storage in the Late Holocene, southwestern Cape, South Africa. Journal of Field Archaeology **21**:103-109.

Inskeep, R.R. 1978. The Peopling of Southern Africa. Cape Town : David Philip.

Inskeep, R.R. 1987. Nelson Bay Cave, Cape Province, South Africa. The Holocene Levels, British Archaeological Reports International Series **357**(II). Oxford: British Archaeological Reports.

Jerardino, A. 1993. Mid to late Holocene sea-level fluctuations: The archaeological evidence at Tortoise Cave, south-western Cape, South Africa. South African Journal of Science **89**:481- 488.

Kaplan, J. 1984. Renbaan Cave : Stone tools, settlement and subsistence. Unpublished B.A. (Hons) thesis, Department of Archaeology, University of Cape Town.

Kaplan, J. 1987. Settlement and subsistence at Renbaan Cave. In J. Parkington and M.Hall (eds). Papers in the Prehistory of the Western Cape, South Africa. pp.350-376. British Archaeological Reports International Series **332**(ii). Oxford: British Archaeological Reports.

Klein, R.G. 1972a. Preliminary Report on the July through September 1970 Excavations of Nelson Bay Cave, Plettenberg Bay. Cape Province, South Africa. Palaeoecology of Africa **6**:177-208.

Klein, R.G. 1972b. The late Quaternary mammalian fauna of Nelson Bay Cave (Cape Province South Africa): its implications for megafuanal extinctions and environmental and cultural change. Quaternary Research **2**:135-42.

Klein, R.G. 1980. Environmental and ecological implications of large mammals from upper Pleistocene and Holocene sites in Southern Africa. Annals of the South African Museum **81**:223-283.

Klein, R.G. 1984. Mammalian extinctions and Stone Age people in Africa. In Martin, P.S. & R.G. Klein (eds). Quaternary extinctions: a prehistoric revolution, pp. 553-73. Tucson: University of Arizona Press.

Klein, R.G. 1986 The prehistory of Stone Age herders in the Cape Province of South Africa. South African Archaeological Society, Goodwin Series **5**:5-12.

Klein, R.G. & Cruz-Uribe, K. 1984. The analysis of animal bones from archaeological sites. Chicago: University of Chicago Press. U.S.A.

Klein, R.G. & Cruz-Uribe, K. 1987. Large mammal and Tortoise bones from Elands Bay Cave and nearby sites, western Cape Province, South Africa. pp.132-163. Papers in the Prehistory of the Western Cape, South Africa. Parkington, J. & Hall, M. eds, British Archaeological Reports International Series **332**(i). Oxford: British Archaeological Reports.

Klein, R.G. & Cruz-Uribe, K. In press. Exploitation of large Bovids and Seals at Middle and Later Stone Age Sites in South Africa.

Kusaka, T. 1974. The Urohyal of fishes. Tokyo: University of Tokyo Press.

Lamberth, S.J. & Bennett, B.A. 1993. When is an angling fish not an angling fish? Evidence from beach-seine catches in False Bay. In L.E. Beckley, R.P. van der Elst (eds). Proceedings of the second South African Marine Linefish Symposium, Durban. 153-156. Oceanograpgic Research Institute, Durban.

Lamberth, S.J., Bennett, B.A. & Clark, B.M. 1995. The vulnerability of fish to capture by commercial beach-seine nets in False Bay, South Africa. South African Journal of Marine Science **15**:25-31.

Lamberth, S.J., Bennett, B.A. Clark, B.M. & Janssens, M.P. 1995. The impact of beach-seine netting on the benthic flora and fauna of False Bay, South Africa. South African Journal of Marine Science 15:115-122.

Lamberth, S.J., Clark, B.M. & Bennett, B.A. 1995. Seasonality of beach-seine catches in False Bay, South Africa and implications of mangement. South African Journal of Marine Science 15:157-167.

Lane, S.B. 1980. Interpretation of digital landsat-1 imagery from Verlorenvlei, southwestern Cape, University of Cape Town, M.Sc. thesis.

Leibbrandt, H.C.V. 1902. Precis of the archives of the Cape of Good Hope. Journal, 1671-1674 & 1676. Cape Town: W.A. Richards & Sons.

Leibbrandt, H.C.V. n.d. Precis and translation of Journal, 1677-1683. Cape Archives Manuscript.

Lepiksaar, J. 1973. Fischknochenfunde aus der phönizichen Faktorei von Toscanos. Studien uber frühe Tierknochenfunde von der Iberischen Halbinsel 4:109-119.

Lewis-Williams, J.D., Dowson, T.A. & Deacon, J. 1993. Rock art and changing perceptions of southern Africa's past: Ezeljagdspoort reviewed. Antiquity 67:273-91.

Lichtenstein, W.H.C. 1815. Travels in South Africa in the years 1803, 1804, 1805, and 1806 Vol.2 (Trans. by Anne Plumtree) (1930 reprinted edition) Cape Town: Van Riebeeck society.

Liengme, C. 1987. Botanical remains from archaeological sites in the western Cape. In Parkington, J. & Hall, M. (eds). Papers in prehistory of the Western Cape, South Africa, pp.237-261, British Archaeological Reports International Series **332**. Oxford: British Archaeological Reports.

Louw, J.T. 1960. Prehistory of the Matjes River Rock shelter. National Museum, Bloemfontein. Memoirs No. 1.

Maclaren, P.I.R. 1958. The fishing devices of central and southern Africa. Occasional Papers of the Rhodes-Livingstone Museum. **12**:1-48.

Maggs, T.M.O'C. 1967. "A quantitative analysis of the rock art from a sample area in the western Cape." South African Journal of Science **63**:100-104.

Maggs, T.M.O'C. 1969. Microdistribution of some typologically linked rock paintings from the western Cape. In Hugot, H.J. (ed) Proceedings Sixieme Congres Panafrican de Prehistoire, Dakar. pp. 218-220.

Maggs, T.M.O'C. 1971. "Some observations on the size of human groups during the Late Stone Age", In Schoonraad, M. (ed): Rock Paintings of Southern Africa 49-53. Johannesburg: South African Association for the Advancement of Science, Special Publication **No.2**.

Maggs, T. & Speed, E. 1967. Bonteberg Shelter. South African Archaeological Bulletin **22**:80-93.

Maggs, T. & Ward, V. 1980. Driel Shelter: rescue at a Late Stone Age site on the Tugela River. Annals of the Natal Museum. **24**(1):35-70.

Mallory, K.J. 1970. The bathymetry and microrelief of False Bay. Transactions of the Royal Society of South Africa 39 (2): 109-112.

Martin, A.R.H. 1962. Evidence relating to the Quaternary history of the Wilderness Lakes. Transactions of the Geological Society of South Africa **65**:19-42.

Manhire, A.H. 1981 Rock art of the sandveld. Unpulished MSc (Hon) dissertation, University of Cape Town.

Manhire, A.H. 1984. Stone tools and sandveld settlement. Unpublished M.Sc. thesis, University of Cape Town.

Manhire, A. 1987. Later Stone Age Settlement Patterns in the Sandveld of the southwestern Cape Province, South Africa. British Archaeological Reports International Series **351**. Oxford: British Archaeological Reports.

Manhire, A.H. 1993. A report on the excavations at Faraoskop Rock Shelter in the Graafwater District of the southwestern Cape. Southern African Field Archaeology **2**:3-23.

Manhire, A.H., Parkington, J.E. & van Rijssen, W. 1983. A distributional approach to the interpretation of rock art in the south-western Cape. South African Archaeological Society Goodwin Series **4**:29-33.

Manhire, A.H., Parkington, J.E. & Robey, T.S. 1984. Stone tools and sandveld settlement. In Hall, M. Avery, G., Avery, D.M., Wilson, M.L. & Humphreys, A.J.B. (eds). Frontiers: south African archaeology today: 111-120. Oxford: British Archaeological Reports.

Manhire, T., Parkington, J. & Yates, R. 1985. Nets and fully recurved bows: rock paintings and hunting methods in the western Cape, South Africa. World Archaeology **17** (2):161-174.

Mazel, A.D. 1986. Mgede Shelter: a mid and late Holocene observation in the western Biggarsberg, Thukela Basin, Natal, South Africa. Annals of the Natal Museum. **27** (2):357-387.

Mazel, A.D. 1988. Nkupe Shelter: report on excavations in the eastern Biggarsberg, Thukela Basin, Natal, South Africa. Annals of the Natal Museum. **29** (2):321-377.

Mehl, J.A.P. 1973. Ecology, osmoregulation and reproduction biology of the white steenbras, *Lithognathus lithognathus* (Teleosti: Sparidae). Zoological Africana **8** (2):157-230.

Meterlerkamp, W. & Sealy, J.C. 1983. Some edible and medicinal plants of the Doorn Karoo. Veld and Flora **69** (1):4-8.

Millar, R.P. 1971. Reproduction in the rock hyrax, *Procavia capensis*. Zoological Africana **6**,2:243-261.

Miller, D.E. 1981. Geoarchaeology Research at Elands Bay. Unpublished B.Sc. (Hons) Project, University of Cape Town.

Miller, D.E. 1987. Geoarchaeology at Verlorenvlei. In J. Parkington and M. Hall. (eds). Papers in the Prehistory of the Western Cape, South Africa, pp.46-77, British Archaeological Reports International Series **332**(1). Oxford: British Archaeological Reports.

Miller, D.E. 1990. A southern African late Quaternary sea level curve. South African Journal of Science **86**:456-458.

Miller, D.E., Yates, R.J., Parkington, J.E. & Vogel, J.C. 1993. Radiocarbon dated evidence relating to a mid Holocene relative high sea level on the south-western Cape coast, South Africa. South African Journal of Science **89**:35-44

Millard, N.A.H. & Scott, K.M.F. 1954. The ecology of South African Estuaries. Part VI: Milnerton estuary and the Diep River, Cape. Transactions of the Royal Society of South Africa **34**:279-324.

Milton, S.J. 1978. Plant communities of Andriesgrond, Clanwilliam district. Unpublished report of the Habitat working group, University of Cape Town.

Morales, A. & Rosenlund, K. 1979. Fish bone measurements. Steenstupia: Copenhagen.

Morris Southward, G. 1962. Photographing Halibut Otoliths for measuring growth zones. Journal of Fisheries Research Canada **19**(2):335-337.

Moodie, D. 1960. The Record 1838-41. Cape Town: Belkema.

Mossop, E.E. 1935. The Journal of Hendrik Jacob Wikar (1779). Cape Town: Van Riebeeck Society.

Mulder, P.F.S. 1973. Aspects on the ecology of *Barbus kimberleyensis* and *Barbus holubi* in the Vaal River. Zoological Africana **8**:1-14.

Mugiya, Y. 1964. Calcification in fish and shellfish III. Seasonal occurence of a pre-albumin fraction in the otolith fluid of some fishes corresponding to the period of opaque zone formation in the otolith. Bulletin of the Japanese Society of Scientific Fisheries **30**:955-67, 160-232.

Nackerdien, R. 1989. Klipfonteinrand II: A sign of the times. Unpublished B.A.(Hons) thesis: University of Cape Town.

Netterberg, F. 1979. The interpretation of some basic clacrete types South African Archaeological Bulletin 24:117-122.

Newman, G. 1980. Fishing in False Bay and the management options. Proceedings of a seminar held on the future management of False Bay. ed. B. Gasson 1980.

Noble, R.G. & Hemens, J. 1978. Inland water ecosystems in South Africa a review of research needs. Pretoria. CSIR

Oliver, A. 1977. An archaeological survey of the Cape Peninsula. Unpublished B.A. Honours project, University of Cape Town

Parkington, J.E. 1972. Seasonal mobility in the Later Stone Age. African Studies **31**:223-243.

Parkington, J.E. 1976a. Follow The San: An analysis of seasonality in the prehistory of the southwestern Cape, South Africa. Unpublished Ph.D Thesis, Cambridge University.

Parkington, J.E. 1976b. Coastal settlement between the mouths of the Berg and Olifants Rivers, Cape Province. South African Archaeological Bulletin **31**:127-140.

Parkington, J.E. 1977. Soaqua: Hunter-fisher-gatherers of the Olifants River Valley, western Cape. South African Archaeological Bulletin **32**:150-157.

Parkington, J.E. 1980. Report on archaeological research in the Verlorenvlei, 1976-9. Paper presented at a symposium on conservation at Verlorenvlei, at the University of Cape Town, 1980.

Parkington, J.E. 1981. The effects of environmental change on the scheduling of visits to the Elands Bay Cave, Cape Province, S.A. In Hodder, I. Isaac, G. & Hammond, N. (eds). Patterns of the Past: Studies in honour of David Clarke. Cambridge: Cambridge University Press.

Parkington, J.E. 1983. A trajectory of hunter gatherer change. Paper presented at the Third International Conference on hunter gatherers. Bad Homberg, June 1983.

Parkington, J.E. 1984. Changing views of the Later Stone Age of South Africa. **In** Wendorf, F. & Close, A.E. (eds). Advances in World Archaeology **3**:89-142.

Parkington, J.E. 1989. Interpreting paintings without a commentary: meaning and motive, content and compotition in the rock art of the western Cape, South Africa. Antiquity **63**:13-26.

Parkington, J.E. In Prep. The Monograph of Elands Bay Cave.

Parkington, J.E. & Poggenpoel, C.A. 1971. Excavations at De Hangen. South African Archaeological Bulletin **26**:3-36.

Parkington, J.E. & Poggenpoel, C.A. 1987. Diepkloof Shelter. In J.Parkington and M. Hall. (eds). Papers in the Prehistry of the western Cape, South Africa. pp.269-293, British Archaeological Reports International Series **332**. Oxford: British Archaeological Reports.

Parkington, J., Poggenpoel, C., Buchanan, W., Robey, T., Manhire, A. & Sealy, J. 1988. Holocene coastal settlement patterns in the western Cape. **In** G. Baily and J. Parkington (eds). The Archaeology of prehistoric coastlines, Chap. **3**:22-41. Cambridge: Cambridge University Press.

Parkington, J., Manhire, T. & Yates, R. In Prep. Reading San Images

Parkington, J. & Poggenpoel, C. in Prep. Excavations At Hoedtjiespunt, Saldanha Bay, Cape.

Parkington, J., Klein, R., Halkett, D. & Hart T. In Prep. The excavations of a MSA site near Boegoeberg in the north-western Cape.

Paterson, W. 1789. A Narrative of four journeys into the country of the Hottentots and Caffraria, in the years one thousand seven hundred and seventy-seven, -eight and nine. London: Johnson.

Patrick, M.K. 1984. The possiblity of using Fish Otoliths to determine seasonality in prehistoric cave deposits: The evidence from Elands Bay Cave, Cape Province. Unpublished B.A.(Hons) Project, University of Cape Town.

Poggenpoel, C.A. 1984. The determination of minimum numbers of individual fish from coastal sites in South Africa, 1984. In Hall, M. *et al.* (eds). Frontiers: Southern African Archaeology Today. British Archaeological Reports International series. Oxford: British Archaeological Reports.

Poggenpoel, C.A. 1987. The implications of Fish bone assemblages from Elands Bay Cave, Tortoise Cave and Diepkloof Rock shelter for changes in the Holocene history of the Verlorenvlei. In Parkington J.E. and Hall M. (eds). Papers in the Prehistory of the Western Cape, South Africa, pp.212-236, British Archaeological Reports International Series **332**(1). Oxford: British Archaeological Reports.

Poggenpoel, C.A. In Press The application of Ba/Sr ratio's in fish as a means to determine fish habitat changes during the Holocene in the south-western Cape, South Africa. Paper read at the ICAS fish working group conference in Spain. Madrid 1995.

Poggenpoel, C.A. & Robertshaw, P.T. 1981. The excavation of Smitswinkelbaai Cave. South African Archaeological Bulletin **34** 133:29-35.

Poggenpoel & Riley In prep. The analysis of fish remains from a rescue excavation at Froggy Pond, Simonstown, Cape.

Pollock, D.E. & Christie, N.D. 1976. Studies of the fish and larger Crustacea of the Saldanha region. Unpublished paper read at a symposium on research in the natural sciences at Saldanha Bay and Langebaan Lagoon.

Rankhama, K. & Sahama, T.S. 1952. Geochemistry. Chicago: University of Chicago Press.

Raven-Hart, R. 1967. Before Van Riebeeck. Cape Town: Struik.

Raven-Hart, R. 1971. Cape of Good Hope 1652-1702. Cape Town: Bakema.

Reddering, J.S.V. 1980. What is an Estuary?. South African Journal of Science **76**:341.

Robertshaw, P.T. 1977. Excavations at Paternoster, southwestern Cape. South African Archaeological Bulletin **32**:63-73.

Robertshaw, P.T. 1978. Khoi and San: Coastal Settlement, Freshwater Fishing and Pastoralism in the later prehistory of the western Cape, South Africa. Unpublished Ph.D thesis, University of Cambridge.

Robertshaw, P.T. 1979a. Excavations at Duiker Eiland, Vredenburg District, Cape Province. Annals of the South African Museums Human Sciences **1**:1-25

Robertshaw, P.T. 1979b. Archaeological investigation at Langebaan Lagoon, Cape Province. Palaeoecology of Africa **10**:139-148.

Robey, T. 1984. Burrows and Bedding: Site taphonomy and spatial archaeology at Tortoise Cave. Unpub. M.A. thesis, University of Cape Town.

Robey, T. 1987. The stratigraphic and cultural sequence at Tortoise Cave, Verlorenvlei. In J. Parkington and M. Hall.(eds). Papers in prehistory of the Western Cape, South Africa. pp. 294-325, British Archaeology Reports International Series **332** (ii). Oxford: British Archaeology Reports.

Rosenthal, H.l., Eves, M.M. & Cochran, O.A. 1970. Common strontium of mineralized tissues from marine and sweet water animals. Comparative Biochemistry and Physiology **32**:445-450.

Saitowitz, S.J. 1982. Excavations at De Posthuys. Unpublished Honours Thesis, University of Cape Town.

Sampson, C.G. 1985. Atlas of Stone Age settlement in the central and upper Seacow Valley. Memoirs of the National Museum Bloemfontein **20**:1-116

Sauvage, H.E. 1870. Essai sur la pêche pendant l'époque du renne. Mém. Soc. Acad. Boulogne-sur-Mer (1870-72) **4**:267-6.

Schapera, I. & Farrington, B. (eds). 1933. The early Cape Hottentots. Cape Town: Van Riebeeck Society.

Schoonraad, M. 1962. Rock engravings of a fish from Schweizer-Reneke, Western Transvaal. South African Archaeological Bulletin. **17**:65-129.

Schrire, C. (ed.). 1984. Past and Present in Hunter Gatherer Studies. Orlando: Academic Press.

Schrire, C. 1987. The Historical Archaeology of Colonial indigenous interactions in South Africa: Proposed research at Oude Post I, Cape. In J. Parkington and M. Hall. (eds.) People and Places. pp.424-461. British Archaeological Reports International Series **332**(ii). Oxford: British Archaeological Reports.

Schrire, C. 1990. Excavation archives at Oudepost 1 Social Dynamics. **16**,1:11-21.

Schrire, C. 1995. Digging in Darkness. Chronicals of an Archaeologist. USA: University Press of Virginia.

Schrire, C. & Deacon, J. 1989. The indigenous artefacts from Oudepost I, a colonial outpost of the VOC at Saldanha Bay, Cape. South African Archaeological Bulletin **44**:105-13.

Schrire, C., Deetz, J., Lubinsky, D. & Poggenpoel, C. 1990. The chronology of Oudepost 1, Cape, as inferred from an analysis of clay pipes. Journal of Archaeological Science **17**:1-32.

Schrire, C., Cruz-Uribe, K. & Klose, J. 1993. The site history of the historical site at Oudepost 1, Cape. South African Archaeological Society Goodwin Series **7**:21-32.

Schweitzer, F.R. 1974. Archaeological evidence for sheep at the Cape. South African Archaeological Bulletin **29**:75-82.

Schweitzer, F.R. 1979. Excavations at Die Kelders. Cape Province, South Africa: The Holocene Deposits. Annals of the South African Museum **78**(10):101-233.

Schweitzer, F.R. & Wilson, M.L. 1982. Byneskranskop 1, A late Quaternary living site in the southern Cape Province, South Africa. Annals of the South African Museum **88**(1):1-203.

Scott, H.A. & Hamman, K.C.D. 1984. Freshwater fishes of the Cape. Cape Conservation Series **5**. Cape Town. Cape Department of Nature and Environmental Conservation.

Scott, K.M.F., Harrison, A.D. & Macnae, W. 1952. The ecology of South African Estuaries. part **2**: The Klein River estuary Hermanus. Transcations of the Royal Society of South Africa **33**:283-331.

Sealy, J. 1986. Stable carbon isotopes and prehistoric diets in the south-western Cape, South Africa. British Archaeological Reports International Series **293**. Oxford: British Archaeological Report.

Sealy, J. & van der Merwe, N.J. 1986. Isotope assessment and the seasonal mobility hypothesis in the south-western Cape, South Africa. Current Anthropology **27**:135-150.

Sealy, J. & Sillen, A. 1988. Sr and Sr/Ca in marine and terrestrial foodwebs in south-western Cape, South Africa. Journal of Archaeological Science **15**:425-438.

Sealy, J. & van der Merwe, N.J. 1986. Isotope assessment and the seasonal mobility hypothesis in the south-western Cape, South Africa. Current Anthropology **27**:135-150.

Sealy, J. & Yates, R. 1994. The chronology of the introduction of pastoralism to the Cape, South Africa. Antiquity **68**:58-67.

Shackleton, N.J. 1973. Oxygen isotope analysis as a means of determining season of occupation of prehistoric midden sites. Archaeometry **15**:133-141.

Shannon, L.V. & Stander, G.H. 1977. Physical and chemical characteristics of water in Saldanha Bay and Langebaan Lagoon. Transactions of the Royal Society of South Africa 42:441-460.

Shawcross, W. 1967. An investigation of prehistoric diet and economy on a coastal site at Galatea Bay, New Zealand. Proceedings of the Prehistoric Society **33**:107-131.

Sinclair, S.A., Lane, S.B. & Grindley, J.R. 1986. Estuaries of the Cape, Part II, synopses of available information on individual systems. Report **32**: Verlorenvlei (cw13). CSIR Research Report **431**, Pretoria.

Singer, R. & Wymer, J. 1982. The Middle Stone Age at Klasies River Mouth in South Africa. Chicago: University of Chicago Press.

Sleigh, D. 1987. Die buiteposte in die ekonomie van die Kaapse verversingstasie 1652-1795. Ph.D dissertation, University of Stellenbosch.

Smith, A.B. 1981. An archaeological investigation of the Holocene deposits at Rooiels Cave, south-western Cape. South African Archaeological Bulletin **36**:75-83.

Smith, A.B. 1985. Excavations at Kasteelberg, Cape Province. Nyame Akuma **26**:37-8.

Smith, A.B. 1986. Competition, conflict and clientship: Khoi and San relationships in the western Cape. South African Archaeological Society Goodwin Series **4**:36-41.

Smith, A.B. & Ripp, M.J. 1978. An archaeological reconnaissance of the Doorn/Tanqua Karoo. South African Archaeological Bulletin **33**:118-127.

Smith, J.L.B. 1953. The Sea Fishes of Southern Africa. South Africa: Central News Agency.

Smith, J.L.B. & Smith. M.M. 1966. Fishes of the Tsitsikama Coastal National Park. National Parks Board of Trustees, Republic of South Africa.

Smith, M.M. 1975. Common and scientific names of the fishes of southern Africa: Part I marine fishes. JLB Smith Institute of Ichthyology Special Publication No. **14**. South Africa: Rhodes University.

Smits, L.G.A. 1967. Fishing scenes from Botsabelo, Lesotho. South African Archaeological Bulletin **22**:60-7.

Stander, G.H. 1969. The South African Marine Resources In Firth, F.E. (ed.) Encyclopedia of Marine Resources New York: Van Nostrand Reinhold Co.

Stewart, K.M. 1989. Fishing sites of the North and East Africa in the Late Pleistocene and Holocene. Environmental and Human adaptions. Cambridge Monographs in African Archaeology 34. British Archaeological Reports International Series 521.

Tankard, A.J. 1975. Thermally anomalous late Pleistocene molluscs from the south-western Cape Province, South Africa. Annals of the South African Museum **69**:17-45.

Tankard, A.J. 1976. Pleistocene history and coastal morphology of the Ysterfontein Elands Bay area, Cape Province. Annals of the South African Museum **69**:73-119.

Taylor, H.C. 1978. Phytogeography and ecology of Capensis In Werger, M.J.A. (ed.). Biogeography and ecology of southern Africa. The Hague, Junk : 171-230.

Tolbot, F. 1955. Notes on the biology of the white stumpnose, *Rhabdosargus globiceps* (Cuiver), and on the fish fauna of the Klein River estuary. Transactions of the Royal Society of South Africa **34**, 3.

Thom, H.B. (ed.) 1952. Journal of Jan van Riebeeck. Cape Town: Van Riebeeck Society.

Thom, H.B. (ed.) 1954. Journal of Jan van Riebeeck. Cape Town: Van Riebeeck Society.

Thom, H.B. 1958. (ed.) Journal of Jan van Riebeeck. Vol.**3**: 1659-1662.

Thomson, W.W. 1913, The Sea Fisheries of the Cape Colony. From Van Riebeeck's days to the eve of the Union. Cape Town: Maskew Miller

Van der Elst, R. 1981. A guide to the common fishes of Southern Africa. Cape Town: Struik Publishers.

Van Neer, W. 1989. Contributions a l'ostéométrie de la Perche du Nil *Lates niloticus* (Linnaeus 1758). Fiches d'ostéologie animale pour l'archéologie, Sene A: Poissons No5. Centre de Recherches Archéologiques du CNRS, Juan-les-Pins.

Van Noten, F.L. 1967 Excavations at Gordon's Bay Shell midden. Inventaria Archaeologica Africana 3.

Van Noten, F.L. 1974. Excavations at the Gordon's Bay shell midden, south-western Cape. South African Archaeological Bulletin **29**:122-142.

Vinnicombe, P. 1960. A Fishing scene from the Tsoelike River, South eastern Basutoland. South African Archaeological Bulletin **15**:15-19.

Vinnicombe, P. 1961. A painting of a fish trap on Bamboo Mountain, Underberg District, Southern Natal. South African Archaeological Bulletin **16**:114-115.

Volman, T.P. 1984. Early prehistory of southern Africa. In Klein R.G. (ed.). Southern African Prehistory and Palaeoenvironments, pp. 169-220. Rotterdam: Balkema.

Von Brandt, A. 1984. Fish Catching Methods of the World. Farnham, Surrey: Fishing News Book.

Waterhouse, G. (ed.) 1932. Simon van der Stel's Journal. Dublin: University Press.

Wallace, J.H. 1975. The estuarine fishes of the East Coast of South Africa. I: Species composition and length distribution in the estuarine and marine environments. II Seasonal abundance and migrations. Investigational Reports of the Oceanographic Research Institute **40**:1-72.

Wallace, J.H., Kok, H.M., Beckley, L.E., Bennett, B., Blader, S.T.M. & Witfield, A.K. 1984. South African Estuaries and their importance to fishes. South African Journal of Science **80**:203-207.

Wendt, W.E. 1976. "Art Mobilier" from Apollo II cave, South West Africa: Africa's oldest dated works of art. South African Archaeological Bulletin **31**:5-11.

Wheeler, A. & Jones, A.K.J. 1989. Fishes: Cambridge Manuals in Archaeology. Cambridge: Cambridge University Press.

Wilcox, A.R. 1965. Archaeological notes from northern Cape. South African Archaeological Bulletin **20**:139-40.

Woodborne, S., Hart, K. & Parkington, E. 1995. Seal Bones as Indicators of the timing and duration of Hunter-Gatherer Coastal Visits. Journal of Archaeological Science **22**:727-740

Yates, R.J., Golson, J. & Hall, M.J. 1985. Trance performance: the rock art of Boontjieskloof and Sevilla. South African archaeological Bullitin **40**:70-80.

Yates, R.J., Miller, D.E., Halkett, D.J., Manhire, A. H., Parkington, J.E. & Vogel, J.C. 1986. A late mid Holocene high sea-level: a preliminary report on geoarchaeology at Elands Bay, western Cape Province, South Africa. South African Journal of Science **82**:164-165.

Yates, R.J. & Manhire, A.H. 1991. Shamanism and Rock paintings: aspects of the use of rock art in the south-western Cape, South Africa. South African archaeological Bulletin **46**:3-11.

Yates R., Woodborne, S. & Hall, M. 1996. The cronology of colonial settlement at the Cape of Good Hope: Clay Tobacco pipes. Paper submitted to the Soiuth African Journal of Sience 1996.

Yeld, J. & Gubb, A. 1993. Trek-fishing: An old tradition threatened. African Wildlife **46**: No 5.